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ABSTRACT OF DISSERTATION

EFFICACY OF THE TRANSTHEORETICAL MODEL IN IMPROVING EXERCISE AND DIETARY HABITS IN ENLISTED AIR FORCE PERSONNEL

As a means of maintaining a fit and ready force, the United States military establishment has always incorporated fitness and weight standards for its personnel. According to USAF data, most personnel pass their fitness tests. However, one particular segment, men between 30 to 44 years of age, have lower scores and appear to have more difficulty passing. Although the USAF has existing nutrition and exercise programs to improve these health habits, they may only be suited for individuals motivated to change these behaviors. According to previous behavior change studies, a better approach is to use stage-matched interventions based on the Transtheoretical model. In short, devise programs that correctly identify an individual's motivation for engaging in a health behavior (stage of readiness to improve) and then match the appropriate intervention for the individual.

Thirty-nine USAF men ranging in age from 30 to 44 were randomly assigned to either a treatment (have access to the stage-matched intervention program) or control (no access to program) group for a six-month period of time. There was no evidence that treatment group exposure to the program was effective in increasing VO_2 levels in treatment subjects. The data suggest that the physical activity tailored information content was not effective in encouraging greater exercise intensity to positively impact fitness levels. However, the dietary-tailored information appears to have encouraged the adoption of more positive nutritional practices, as manifested by the beneficial effects seen in certain secondary outcomes (significant decreases in weight, body mass index and percent body fat).

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DISSERTATION

EFFICACY OF THE TRANSTHEORETICAL MODEL IN IMPROVING EXERCISE AND DIETARY HABITS IN ENLISTED AIR FORCE PERSONNEL

Submitted by

Donald Victor Veverka

Department of Food Science and Human Nutrition

In partial fulfillment of the requirements

for the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY DONALD V. VEVERKA ENTITLED **EFFICACY OF THE TRANSTHEORETICAL MODEL IN IMPROVING EXERCISE AND DIETARY HABITS IN ENLISTED AIR FORCE PERSONNEL** BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

Committee on Graduate Work

Phillip L. Chapman

Cathy Kennedy

Gary R. Coulter

Gary W Ald

Co-Adviser

Jennifer Anderson

Adviser

Art Campfield

Department Head

ABSTRACT OF DISSERTATION

EFFICACY OF THE TRANSTHEORETICAL MODEL IN IMPROVING EXERCISE AND DIETARY HABITS IN ENLISTED AIR FORCE PERSONNEL

As a means of maintaining a fit and ready force, the United States military establishment has always incorporated fitness and weight standards for its personnel. According to data obtained by the U.S. Air Force (USAF) Surgeon General's Office, most personnel pass their fitness tests. However, one particular segment, men between 30 to 44 years of age, have lower scores and appear to have more difficulty passing. Although the USAF has existing nutrition and exercise programs to assist efforts towards greater physical fitness levels and improved dietary habits, these programs may only be suited for individuals that are motivated to improve these behaviors. According to the literature, there are individuals that may need to improve dietary and physical activity behaviors but are not motivated to do so. A more effective approach, according to previous behavior change studies, is to implement a strategy, which uses stage-matched interventions based on the Transtheoretical model (TTM). In short, devise programs that correctly identify an individual's motivation for engaging in a health behavior (stage of readiness to improve) and then match the appropriate intervention for the individual.

Using male enlisted Air Force personnel between the ages of 30-44 as the target population, focus groups were used to obtain qualitative information on diet and exercise

habits to improve fitness scores. Results revealed that participants needed assistance in obtaining information concerning both diet and exercise in order to successfully define and implement a program which would lead to increased fitness. Further, participants selected various methods by which to receive this information. Specifically, to help increase their physical activity, participants needed further education on cycle ergometry, goal-setting, and ways to avoid injury during exercise. In order for test subjects to develop healthy eating habits, the group was provided information on how to sort out media misinformation, prepare healthy foods quickly, understand food labels and determine safety and efficacy of popular dietary supplements. Handout literature, web sites and seminar/discussion formats were the most effective ways for test subjects to receive information. Using the qualitative focus group data from the aforementioned target population, an intervention program based on the TTM was developed and provided via the worldwide web. Use of interactive technology such as computers and the Internet are strongly advocated by health promotion professionals as an effective means of reaching large numbers of at risk populations with specifically tailored information.

There was no evidence that treatment group exposure to the web site program was effective in increasing fitness scores. The data suggest that the physical activity-tailored information content was not effective in encouraging greater exercise intensity which positively impacted fitness levels. However, the dietary-tailored information appears to have encouraged the adoption of more positive nutritional practices, as manifested by the beneficial effects seen in certain secondary outcomes. Stage progression was evident as more treatment subjects than controls advanced to higher stages of positive dietary and

exercise behaviors. More treatment group subjects reported improved dietary behaviors than reported increases in exercise behaviors. Treatment subjects did not report any relapse in physical activity as opposed to control subjects who reported a high level of regression towards sedentary physical behaviors.

Donald V. Veverka
Department of Food Science and Human Nutrition
Colorado State University
Fort Collins, CO 80523
Fall 2001

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CHAPTER 1

INTRODUCTION

Rationale for Research

Research has repeatedly shown that physical activity and diet play key roles in health promotion and disease prevention. Half of the leading causes of death in the U.S. are directly related to dietary practices (11). Physical inactivity is acknowledged as an independent cardiovascular disease risk factor similar to smoking, hypertension and hypercholesterolemia (26). Lindsted (32, 33) reported Seventh Day Adventist men who engage in regular physical activity and adhere to the restrictive health promoting regimen (refrain from smoking, alcohol, caffeine, consume only vegetarian diets) have greater lean mass and lower mortality rates than men in the general U.S. population. In spite of ongoing efforts to widely disseminate information regarding proper physical activity and diet, nearly 60 percent of Americans engage in little or no form of regular physical activity (4, 5). While fat intake is decreasing per capita, it is still beyond recommended levels for optimum health (25). Likewise, fruit and vegetable intake remains below recommended levels (23, 31, 47, 50).

One might expect the personal health habits of military personnel would compare favorably with those of civilians. While this is true for some lifestyle behaviors, it is not always the case for others (14, 53, 55). Recent United States Air Force (USAF) and

Department of Defense (DoD) studies have shown that military personnel practice a variety of unhealthy behaviors which cost several million dollars in direct health care costs and lost productivity (9, 10). In 1995, an Air Force Behavioral Risk Factor Surveillance Study (7) found only 76 percent of the active duty personnel reported their health as good or excellent and 14 percent provided height and weight measurements that yielded a body mass index exceeding Centers for Disease Control criteria for recommended health. A 1998 DoD survey showed that USAF members have the lowest total involvement in strenuous physical activity of any of the military services (8). Recent data (6) from the Air Force Medical Operations Agency in Bolling Air Force Base, Washington, D.C., show that, in 1998, males in the age group 35-44 pass their ergometry test by much smaller margins than other male age groups or women in the same age group (see Figure 1.1). Additionally, men in the age group from 30-34 do not meet American College of Sports Medicine criteria for well-trained individuals in the general population for the same gender and age (6).

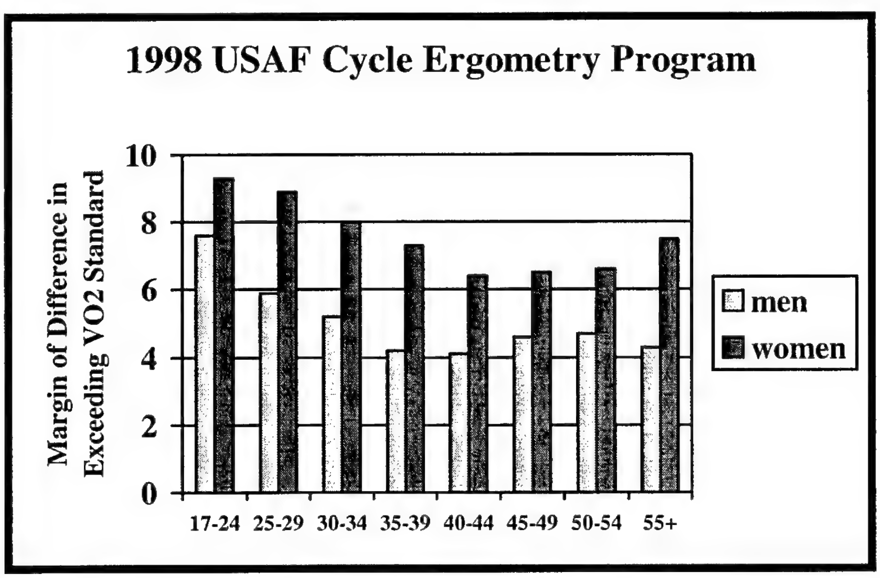

Figure 1.1. 1998 USAF Cycle Ergometry Program.

Although Air Force nutrition and exercise programs exist to aid individual efforts towards greater physical fitness levels and improved dietary habits, these programs do not consider the cognitive state of preparedness to change in the individual. In other words, most exercise and nutrition programs are designed for those who have made the commitment to be physically active and eat nutritionally balanced meals. Maintaining good nutritional and exercise habits remain elusive for some, especially for those who have difficulty reaching prescribed military standards. Marcus (39) showed that scores on a physical activity behavior survey conducted at a worksite significantly differentiated employees among various behavioral stages of preparedness. According to the literature (29, 40, 42, 44, 45, 46, 48), a more effective approach is to implement a strategy that uses stage-matched materials based on Prochaska's Transtheoretical Model of Behavior Change (TTM) (42, 43). In other words, devise programs that correctly identify the particular needs of the individual for the current health behavior exhibited and then match the appropriate intervention for the treatment. Specifically, the model asserts that people change their behaviors over time in a series of five stages. The five stages include precontemplation (no intention to change in next six months), contemplation (intention to change in next six months), preparation (enacting some of the new behavior and committing to a change in next 30 days), action (fully participating in the new behavior but for less than six months), maintenance (fully participating in the new behavior for more than six months).

While considerable study has uncovered the efficacy of the TTM in promoting positive behavior change in diet and physical activity patterns, little has been revealed in terms of using computer/web technology in concert with the model (27, 37). There is

growing interest in developing less intensive but more encompassing and far-reaching health promotion interventions, especially in the managed care environment rapidly expanding within the U.S. Often known as self-administered interventions, there is increasing appeal for use of these types of programs because they enhance reach, efficiency and efficacy of health education efforts as opposed to more intensive and expensive usual care options (16).

Additionally, the majority of the work done with the TTM provided results from self-reported or research investigator-led surveys (18, 19, 20, 21, 24, 34, 35, 51). Recently, TTM advocates have called for more objective verification of behavioral results (27, 29, 35, 36). Whereas earlier TTM research evaluated effects using these subjective data collection methods, this study reported here measured both behavioral and physiological outcomes using combinations of self-report and objective assessment tools.

The USAF has encouraged new and innovative health research initiatives as part of the *2000 Air Force Healthy Communities Research Program* (12). Using the *Healthy People 2010* objectives and DoD directives as a foundation, this program calls for more research pertaining to innovative health promotion and disease prevention methods. Specifically, within the topic areas of "physical activity and fitness" and "nutrition," the Air Force has requested further investigation regarding: 1) adoption of healthy behavior patterns, including social skills, attitudes and knowledge of adopting regular activity programs, 2) develop effective educational methods to translate dietary recommendations into appropriate food choices and sustained behavioral changes, 3) explore reasons people change or do not change behavior related to health as a result of exposure to

health promotion programs, and 4) study and development of work-site programs and their impact of likelihood to make needed lifestyle changes.

Because of the U.S. Air Force's reputation as a technologically-driven service, it is plausible that the use of computers and the Internet to promote health education efforts would be of use in terms of reach and effectiveness. Further, due to the paucity of research associated with using the TTM in military populations, additional study would add to the growing litany of studies involving this particular behavior change model. Studies such as these which measure the efficacy of combining both aspects of computer/web technology in concert with the TTM in achieving USAF health promotion objectives are clearly warranted.

Health Promotion in the Military

As a means of maintaining a fit and ready force, the United States military establishment has always incorporated fitness and weight standards for its personnel. Commensurate with these standards are various efforts by the military medical corps to aid personnel in meeting prescribed physical benchmarks. Although professing the need for adequate nutrition and physical fitness, the evolution of health promotion in the military has been erratic. At times, it has influenced the private sector; in recent times, it has reflected it (22). Amid the growing pressures of downsizing in the military, the call for economies and efficiencies within our nation's defense structure has resulted in enhanced effectiveness of health care delivery (22). Historically, the focus in the military has been on fitness standards to maintain readiness. With the advent of shrinking medical staff due to Department of Defense restructuring, soaring medical costs and the

implementation of new medical programs, the thrust of medical intervention has been placed on health risk reduction and health promotion activity (22).

Nationally, during the 1970s, there began an increasing awareness that premature mortality and morbidity are related to personal behavior (15). In addition, the media began calling more attention to one's personal responsibility for health (49). In 1976, President Ford signed into law the National Consumer Health Information and Health Promotion Act, which established a national program of health information, health promotion, preventive health services and education in the appropriate use of health care (49). In 1979, *Healthy People* (1), as issued by former Surgeon General, Dr Julius Richmond, clearly expressed national health objectives to be achieved by 1990. The main point of this publication was that improved health was attainable by concentrating on individual behaviors and the environment to reduce risk factors associated with cancer, coronary heart disease and infant mortality. Eventually, these objectives became the central dogma for all worksite health promotion program developers (22).

National policy statements such as those in Healthy People have influenced military health promotion efforts. In 1986, the DoD released a directive which established health promotion policy for the services (3). The purpose of the document was "to improve and maintain military readiness and the quality of life for DoD personnel and their beneficiaries." The thrust of the directive aimed at 1) smoking prevention and cessation, 2) physical fitness, 3) improved nutrition, 4) stress management, 5) alcohol and drug abuse prevention, and 6) early identification of hypertension (3). While the individual services successfully integrated these ideals within existing medical or personnel functions, a 1991 General Accounting Office audit

found that military medical and personnel health programs were not themselves integrated. In other words, facilities used for physical fitness programs were not funded or maintained as an integral part of health promotion programs (17).

As has been the case with their civilian counterparts, the DoD medical community has also had to deal with upward spiraling medical costs of peacetime health care as a benefit of employment to active duty personnel, retirees and their families. The DoD, similar to the private sector, has moved to the managed care arena in an effort to meet increasing medical demands. These programs have health promotion as a central theme towards improving economies/efficiencies within the medical establishment (22).

As a result of these evolutionary changes, the USAF established Health and Wellness Centers (HAWCs) at every main installation. These centers underscore the ideals as prescribed by the 1986 DoD directive and provide an essential health promotion asset within the USAF's medical corps. Each HAWC has a myriad of programs and equipment that target individual health by facilitating the requisite lifestyle changes for long-term wellness and purposely integrates the total military community to include DoD civilians, retirees and their families. Part of the HAWC's responsibility is to implement and manage an installation-wide fitness testing program for the active duty population. An integral part of this program is cycle ergometry, used to assess cardiovascular conditioning. Adopted by the USAF in the early 1990s, the test runs 6-10 minutes in length and consists of pedaling a stationary bike at various workloads while changes in heart rate are monitored. A computer program calculates an estimated oxygen consumption VO_2 (volume of oxygen) based on the individual age, gender, height, weight, resting heart rate and workload. Using these data, a VO_2 score is derived and

compared against USAF standards by age and gender (41). Successfully passing this test depends on proper nutrition, the level of conditioning one has obtained, as well as how much a person weighs for their particular height and gender. Thus, diet and exercise play a fundamental role in promoting and maintaining USAF health fitness standards.

Project Objectives and Hypothesis

A two-fold study, the purpose of research reported here is to determine whether using internet technology in concert with Prochaska's TTM to change exercise and nutrition habits will result in statistically significant improvement in fitness scores compared with individual self-directed efforts. The development phase entailed using focus group data and recommendations from the literature to design a web site intervention program, *Let's Get Moving!* The second phase of the research evaluated the effectiveness of the developed intervention using a randomized controlled design. The ultimate objective of the intervention was to improve fitness levels in male enlisted USAF personnel between the ages of 30-44 through behavior change. Secondary objectives included changing certain dietary and physical activity habits as a means of improving fitness levels in the targeted group.

It is hypothesized that application of stage-matched health education materials made available via the Internet will result in improved fitness scores. Dietary and physical activity outcomes (behavioral and physiological) were measured quantitatively by physiological and self-report measures:

Anticipated behavioral outcomes:

- Reduction in calories from the diet
- Decrease in percentage of energy from fat
- Increase in fiber intake

- Increase in fruit and vegetable intake
- Increase of recurring physical activity

Anticipated physiological Outcomes:

- Decrease in blood pressure
- Decrease in body fat percent
- Decrease in BMI
- Decrease in lipid and LDL-cholesterol levels
- Decrease in waist-to-hip ratio
- Decrease in resting heart rate
- Increase in VO_2 fitness scores

Theoretical Basis

Theory, according to Webster's Dictionary, "is systemically organized knowledge applicable in a relatively wide variety of circumstances, especially a system of assumptions, accepted principles, and rules of procedure devised to analyze, predict, or otherwise explain a specified set of phenomena" (2). For a nutrition educator, theory is important in understanding the dietary practices of individuals and then applying its framework in an effort to improve health. Use of theory in nutrition education is vital from the standpoint that it provides a strategy for promoting healthful eating and living in a natural setting (28). Earlier reviews (30, 54) of nutrition education research conducted in the 1970s and 1980s reported few, if any, work which used a theoretical framework to design an intervention. In addition to having an effective intervention, it is also important to know the reasons for a successful program. Auld's work (13) with theoretically-based cooking classes provides an illustration. Using elements of the Social Learning Theory and Diffusions of Innovations Theory, researchers were able to increase the use of certain commodity foods and, at the same time, interpret the operative aspects of the intervention that promoted change in using these foods. Understanding the tenets of each theory

helped researchers implement effective programs and explain results in a manner conducive to further study. This work added to the growing body of literature that validates particular theories useful for devising effective nutrition education programs.

Selecting an appropriate theory upon which to base the study was challenging due to the vast possibilities that exist. Prochaska's TTM was chosen because it incorporates other important singular elements for behavior change from other successful behavior change models. In addition to considering the particular motivational stages a person may be in at a given time, the model also incorporates self-efficacy (build confidence for new behavior), decisional balance (increase benefits for new behaviors), and processes of change (raise awareness of problem behaviors, encourage self-evaluation, solicit support from friends and family, avoiding temptation/relapse and practicing new behaviors in a social setting). Close examination of existing health promotion programs in the Air Force revealed efforts that treated all individuals the same when found in need of appropriate diet and exercise guidance. Prochaska (43) alluded to this as a possible reason why some individuals do not succeed in changing toward healthier lifestyles. In other words, health professionals should take into consideration the state of a person's cognitive state to change and then provide assistance according their particular stage of readiness to change. Although previous work has not shown differentiation of military personnel across the five stages of the TTM, other studies, using both male and female populations, have revealed stage differentiation across both dietary and physical activity behaviors (24, 38, 52). Further, preliminary data indicated stage differentiation for the study sample, both for diet and exercise behavior. Accordingly, the TTM was selected as

the theoretical basis for developing and evaluating an experimental intervention for changing nutritional and physical activity behaviors in this particular audience.

Assumptions and Limitations

The focus of the study primarily aimed at USAF male enlisted personnel in need of improving individual fitness levels. Time and funding constraints preclude obtaining a wide variety of USAF personnel on a world-wide basis, thus generalizability is limited. The particular sample that volunteered for this study comprised a wide variety of career interests, educational backgrounds, ethnicities, and other demographic characteristics similar to that found on other USAF installations. There will also be an element of self-selection bias with the participants. It is expected that those who volunteer will be more aware of health-conscious habits than individuals who would be randomly selected from the population. Additionally, because of the need for military populations to meet weight and fitness standards, it is assumed that lower numbers will be seen in the early stages of the TTM such as precontemplative and contemplative. Thus, sample sizes within each category may be insufficient in those particular categories.

Cross-contamination between control and treatment groups is a possibility. However, to limit this from occurring, only treatment group participants had access to the secure web site with their own personal code number. Additionally, at the end of the study, control participants were queried whether they had received any treatment materials during the course of the study.

Access to computers was a possible limitation for some participants. While it was determined that a majority of those had access, either at work or at home, a few may have

had difficulty getting to a computer workstation. Accommodations were made with each unit to allow participants the chance to use a computer in the participant's orderly room or Learning Resources Center.

Depending on the world situation, some participants may need to deploy for regional crises. However, due to the nature of the intervention using the world wide web, participants can still have access to the intervention as long as a computer is made available. In most situations, deployed members have access to computers to send e-mail messages. As a result, most will have the opportunity to continue in the study irrespective of deployment status.

Other limitations include applicability to other personnel within the USAF, such as women or commissioned officers. Further study would be required to ascertain effectiveness in groups outside of the current study sample.

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DIET AND PHYSICAL ACTIVITY STAGING ALGORITHMS

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CHAPTER 2

REVIEW OF THE LITERATURE

Health Behaviors of Military Personnel

Acknowledgement that dietary and physical activity habits are intimately involved with the origin of some chronic disorders has given impetus to improving health education efforts. Research institutions and health organizations (government and private) continue to tout the importance of healthy eating and exercise practices. The National Cancer Institute has set dietary goals of increasing fiber, fruit and vegetable intakes and lowering fat consumption (86). Both the year 2000 U.S. Dietary Guidelines for Americans (11) and The American Heart Association Dietary Guidelines (96) were revised to call attention to establishing healthy eating patterns that include foods from all the major food groups and to balance energy needs with a level of physical fitness that achieves fitness. The national disease prevention and health promotion agenda, *Healthy People 2010* (12), builds on initiatives begun two decades ago to strengthen the link between diet and exercise in wellness programs throughout the country.

Although some progress has been made in national health objectives, there remains considerable opportunity to improve in terms of obesity and intake of fat, saturated fat, calcium, sodium, fruit and vegetables (12). Men and women's average intake of fat as a percentage of calories has decreased; however, intakes of total and saturated fat still exceed recommended dietary guidelines (63) and fruit/vegetable intake

is below suggested levels for maintaining good health (32, 145, 173). As an occupational subgroup of the aforementioned population, the military has not been reported on extensively in terms of their diet and physical activity behaviors. This has been largely due to the perception that those within the military have stringent weight and fitness standards to follow. Yet, there has been some limited research regarding these and other behaviors in military personnel that indicate a need for improvement (20).

A retrospective study (180) of U.S. Army and Marine personnel showed that less than half of those studied (43 percent) met the minimum recommendation of five daily servings of fruits and vegetables. Although a small study that evaluated the diets of 798 personnel, the data compared favorably to that of the general U.S. population that reportedly has a much lower percentage meeting recommended guidelines. Two studies (52, 178) in particular looked at military personnel in respect to their overall nutrition knowledge. Conway's (52) work specifically dealt with Navy male recruits prior to joining active duty. Primarily composed of Caucasians and some minorities, the study revealed knowledge shortcomings in how one assesses nutrient needs and whether those needs are being met, naming the major food groups and recommended servings, and the effects of alcohol and drugs on nutritional status. Out of 205 recruits, only 2 percent answered 90 percent or more of the test questions correctly. It was found, however, that these knowledge scores were comparable with their civilian counterparts (61% correct vs. 64%). Conway found that older Caucasian recruits that received higher grades in high school and got into less trouble had higher nutrition knowledge.

Trent's (178) work with Navy personnel provided a baseline assessment of those already on active duty. Using a 40-item questionnaire mailed to 2,938 active duty Navy

personnel, Trent found that nutrition knowledge was highest among older, more educated individuals that were Caucasian, female and commissioned. Overweight individuals were also found to be knowledgeable as well. Trent provided these data to the Navy's nutrition education program and emphasized specific nutritional categories (calories/food intake and carbohydrates) that indicated the need for additional educational efforts. The U.S. Army administered surveys in the 1990s to assess personnel health habits involving tobacco and alcohol use, physical activity, nutrition and other safety-related practices. Given to more than 400,000 soldiers, it made comparisons between those behaviors of the soldiers to that of the *Healthy People 2000* objectives. The U.S. Army found that, while the soldiers exceeded HP 2000 goals for physical fitness and eating high fiber foods, they did not meet goals for nutrition, tobacco use and seat-belt use (185).

In a study conducted by Wetzler and Cruess (181), health practices of U.S. Air Force personnel were compared to their adult U.S. civilian counterparts. Surveying both male and female Air Force personnel, researchers found that USAF males were less active than their civilian counterparts and exhibited a higher percentage of individuals in the 10-30 percent over desirable body weight category (but a much lower percentage for the over 30 percent plus and over group). These same investigators also found that 29 percent of Air Force personnel rarely or never consume a breakfast meal as compared to 18 percent of the civilians polled in the study.

More recent USAF and Department of Defense studies have shown that military personnel practice unhealthy behaviors that have cost several million dollars in direct health care costs and lost productivity annually (10, 172). In 1995, an Air Force Behavioral Risk Factor Surveillance Pilot Study found only 76 percent of the active duty

personnel reported their health as good or excellent and 14 percent provided height and weight measurements that yielded a BMI exceeding CDC criteria for recommended health (7). A 1998 DoD survey showed that USAF members have the lowest total involvement in strenuous physical activity of any of the services (9).

Study Population - United States Air Force Enlisted Men

Enlisted members within the USAF are high school graduates with a high percentage (92%) having attended some college. The particular age group (30-44) targeted are predominantly married (16) and may live on or off base. The enlisted ethnicity groups are 71.2 percent Caucasian, 18 percent African-American, 5.5 percent Hispanic, and all others at 4.5 percent (16). An ethnicity demographic comparison of the study sample relative to the general Air Force population is shown in Figure 2.1. In this particular enlisted age group, many face the decision whether to make the USAF a career and are usually in their third or fourth enlistment (between 12-16+ years of service).

Peterson Air Force Base, Colorado Springs, Colorado, is an active military installation with a wide range of missions, albeit primarily space and missile warning operations. The 21st Space Wing operates missile warning and space control for the North American Aerospace Defense Command (NORAD) and U.S. Space Command through a network of command and control units and ground and space-based sensors. Over 5,000 military personnel support the wing mission in a myriad of career fields (15). Depending on their Air Force Specialty Code (career field), enlisted personnel may endure shift work and are constantly upgrading their career field expertise through on-the-job training and correspondence courses. Various career fields include but are not

limited to administrative, warehousing, medical, hospitality, flight line operations, command and control operations, flight duty, aircraft mechanics, finance, computer and communications, civil engineering, fire department and security/law enforcement.

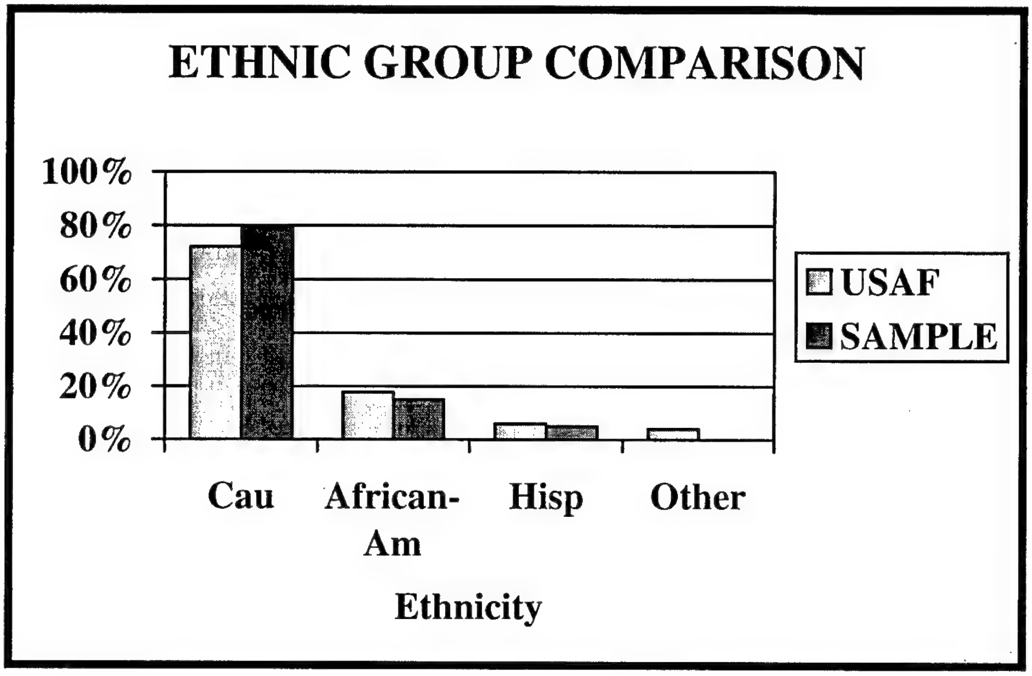

Figure 2.1 Ethnic group comparison between USAF and study sample.

USAF Health Promotion Programs

The current mission of the USAF medical corps is to "expand, mobilize and deploy medical support for contingency operations world wide and develop and operate a comprehensive and cost effective community-based health care system." Specifically, to "promote the health, safety and morale of Air Force people and provide or arrange timely, high quality health care" (13). Within the USAF medical corps is a number of agencies responsible for carrying out the respective programs inherent within this mission. The Air Force Medical Operations Agency (AFMOA) facilitates the execution of procedures, processes, and programs in aerospace medicine, preventive health, clinical

health care, research, and biometrics to enhance force readiness and build healthy communities throughout the Air Force. AFMOA supports a $4.7 billion program with 46,000 medical personnel, 79 medical treatment facilities, and over 2.7 million beneficiaries (13).

Building "healthy communities" is considered an integral part of preserving USAF military readiness. Consequently, the USAF has encouraged newer research initiatives as part of the *2000 Air Force Healthy Communities Research Program* (14). Using the *Healthy People 2010* objectives and a DoD health promotion directive (1) as a foundation, this program calls for more research pertaining to innovative health promotion and disease prevention methods. Specifically, within the topic areas of "physical activity and fitness" and "nutrition," the Air Force has requested further investigation regarding the following areas: 1) adoption of healthy behavior patterns, including social skills, attitudes and knowledge of adopting regular activity programs, 2) developing effective educational methods to translate dietary recommendations into appropriate food choices and sustained behavioral changes, 3) exploring reasons people change or do not change behavior related to health as a result of exposure to health promotion programs, and 4) study and development of work-site programs and their impact of likelihood to make needed lifestyle changes. As a result, USAF research efforts continue to explore innovative programs to promote the health of its personnel.

Although the Department of Defense has set forth health promotion guidance to the respective services, a separate government audit found medical and health promotion activities were not well integrated within the military branches (29). Primarily, the idea was to ensure that resources are set aside separately for personnel health promotion

programs (avoiding the use of clinical and hospital personnel to administer programs by establishing a separate facility staffed with health care professionals solely dedicated to health promotion). In the early 1990s, the Air Force established a unique organization within the Medical Corps that would meet this challenge. Known as *Health and Wellness Centers* (HAWCs), these facilities fulfill a vital part of USAF's prevention programs and are located at virtually every main Air Force installation. These centers underscore the ideals as prescribed by the 1986 DoD directive (1) and provide an essential health promotion asset within the USAF's Medical Corps. Each HAWC has a myriad of programs and equipment that targets individual health needs as well as including activities beyond the worksite and integrates the total military community to include retirees and dependents. Primary responsibilities include tobacco cessation, alcohol and substance abuse interdiction, medical self-care education, disease prevention and management classes (coronary heart disease, diabetes, etc.), fitness enhancement, nutrition and weight management guidance. HAWCs provide the tools that facilitate the indispensable lifestyle changes for long-term success. Ever progressive, HAWCs continually seek out pioneering interventions that can aid a wide range of individuals. Providing a unique program that aids in their mission to increase awareness, educate and motivate toward a life-long healthy lifestyle are of utmost interest. While prevention aims continue within the USAF, recent year draw-downs have severely impacted various HAWC programs, especially those requiring labor-intensive, face-to-face type interactions. The USAF is interested in programs, which could still remain as personal as face-to-face dealings, yet reach more of the at-risk population. Thus, the development of a web-based health promotion program such as *"Let's Get Moving"* offered another

venue to meet USAF health promotion needs. It was a program that could be tailored to specific requirements, yet it demanded fewer medical personnel to administer.

Transtheoretical Model for Behavior Change

There are several models that have been used successfully by health professionals in getting clients to adopt healthy behaviors. The Health Belief Model, Social Learning Theory, Theory of Reasoned Action, Theory of Planned Behavior, Social Marketing and the Transtheoretical Model are among the more popular education models that have been cited in the literature over the last ten years (91, 119). Epstein (64) argues for using a theory or combination of theories that transcend the social, behavioral and biomedical domains and incorporate the findings and language of both basic and applied scientific disciplines. The Transtheoretical model is mentioned as one such possible theory because of its numerous constructs for influencing behavior change. Epstein's point is not that one method is superior to another, but rather does it use social, behavioral and biomedical domains in the application of both basic and applied science. (For example, the TTM considers the social aspects of the behavior, predicts and explains behavior change, and produces desired physiological outcomes such as improved health parameters.) Only additional study can reveal the possibilities.

While there are numerous advantages and disadvantages to each theory, Prochaska's Transtheoretical model (TTM) has demonstrated a higher degree of effectiveness over usual care treatments (117). Prochaska's TTM was chosen because it incorporates several important singular elements for behavior change from other successful behavior change models. Not only does the model consider the particular

motivational stages a person may be in at a given time, it uses the self-efficacy (build confidence for new behavior), decisional balance (increase benefits for new behaviors), and processes of change (raise awareness of problem behaviors, encourage self-evaluation, solicit support from friends and family, avoiding temptation/relapse and practicing new behaviors in a social setting). Tailored to an individual's state of readiness to change a particular behavior, the TTM asserts that a person goes through a series of different stages when changing behavior over time (151). The five specific stages include precontemplation (no intention to change in next six months), contemplation (intention to change in next six months), preparation (enacting some of the new behavior and committing to a change in next 30 days), action (fully participating in the new behavior but for less than six months), maintenance (fully participating in the new behavior for more than six months) (147).

Important aspects of the TTM include the core constructs beyond the specific five stages. These include decisional balance, self-efficacy, and processes of change. Decisional balance is where the individual weighs the pros and cons of making a particular behavior change (93). Self-efficacy places individual importance on whether a person can actually perform the behavior (21, 58). The processes of change construct embodies ten strategies an individual can use in progressing from one stage to the next (152). These are classified as experiential and behavioral types and listed below for reference:

<u>Experiential</u>

1) Consciousness raising – increasing awareness of problem behaviors
2) Dramatic relief – increasing emotional experience regarding problem behavior

3) Self-reevaluation – personal evaluation of the problem behavior

4) Environmental reevaluation – how the problem behavior affects others

5) Self-liberation – belief and commitment to making change to new behavior

Behavioral

1) Helping relationships – social support for the individual changing

2) Counter-conditioning – learn new behaviors to substitute for problem ones

3) Stimulus control – remove cues for problem behaviors and supporting new behaviors

4) Contingency management – rewarding for acquisition of new behaviors, reinforcement

5) Social liberation – increasing social opportunities to practice new behaviors

The TTM has been implemented across a myriad of health behaviors (153), and has been effectively employed in the U.S. as well as in other countries (107, 111). These health behaviors run the gamut from seatbelt use, mammography screening, exercise, diet, smoking and safe sex practices (88, 140, 153). Although considered an effective tool in health promotion intervention efforts, there are those who question its effectiveness and ethical applications. Ashworth (18) argues that there are not enough data that compare TTM-based study with usual care study. In the author's opinion, there are only six studies that made direct comparisons between staged and non-staged interventions. The difficulty lies in drawing generalizations from each study with which to recommend extensive implementation of the TTM in health care practices and settings. Because there have been so many varied applications of the model and very few replicated studies using similar methodologies, one cannot draw conclusions regarding

the model's putative efficacy. Studies did show there appears to be utility in using stage based materials, however, further investigation of TTM interventions in actual heath care practice were warranted to truly validate widespread use (18).

Loughlan (111) reported that use of the TTM could be useful in pre-identifying individuals for study. For example, appropriate materials could best serve those in the contemplative through action stages. Additionally, the intervention would provide the best return for resource dollars in terms of cost effectiveness. The question then remains; do health professionals bypass those in the earliest stage (precontemplative) as unreachable and too expensive to treat? Some would argue that these are the populations that need the treatment the most and ones possibly overlooked based on behavioral staging (183).

As with any theory, interpretations of its use will vary. Bandura (23) posits that the TTM stages do not strictly follow the definitions of stage theory and that "stage thinking can constrain the scope of interventions to promote change." Prochaska (150) counters this idea by explaining that there is a litany of stage theories but no single unifying standard. Further, that stages are not the only aspect of the model—that in fact, there are 14 core constructs that continuously describe behavior change. Equally important, Prochaska (149) makes several fundamental assumptions about the use of the TTM. First, no one theory can account for the intricacies of behavior change. An all inclusive model that incorporates tenants from other theories will be more useful. Second, most traditional interventions are slated toward action-oriented populations and will not aid the majority of targeted individuals. Health promotion efforts need to move from an "action paradigm to a stage-paradigm." Third, one must use the specific

processes and principles of change at the specific stages if improvements are to be realized. Finally, lasting behavioral patterns are typically under a blend of biological, social and self-control influences. The TTM is only appropriate for aiding individuals capable of exercising self-control.

Prochaska (151) points out several key attributes in using the TTM in an intervention: 1) one should view behavior change as a "progression through a series of stages," 2) use proactive recruiting and stage-matched, interactive materials to accentuate impacts on the at-risk population, 3) use multiple venues to integrate health promotion efforts such as worksites, homes, schools, community centers, medical centers, etc., 4) use specific stages of TTM to address the particular needs of the individual. From a very large and growing database of research studies using the TTM, it is evident this unique model has a great potential for successfully instituting positive behavior changes in at-risk populations. The ensuing discussion of work with the TTM emphasizes this point.

Use of the Transtheoretical Model in Various Health Behaviors

Within the document *Healthy People 2010*, several behaviors are tracked as national health objectives for the U.S. These include areas such as immunization, sexually transmitted diseases, prevention, tobacco use, nutrition and physical activity patterns (12). In total, there are 28 focus areas considered essential for improving years and quality of life for all Americans. One of the central precepts of *Healthy People 2010* encourages continuing research and clinical efforts in developing effective interventions that will aid individuals in meeting these national objectives. Worksite interventions are

especially of interest because of the potential to reach large numbers of individuals with information, activities and services that foster the adoption of healthy behaviors (12).

TTM interventions have been found to be particularly useful in modifying individual habits over a broad array of health behaviors. Initial study began in 1983 with smoking cessation therapy. In this work, Prochaska (147) found subjects using various strategies (both cognitive and behavioral), over a period of time, in an attempt to successfully quit smoking. At the time, no other therapy theory considered using these strategies in a temporal fashion to modify behavior. Other researchers naturally sought answers as to generalizability of the TTM to other health risk behaviors (153, 155, 161, 169). Eventually, within the last decade, further study has revealed the TTM is effective for use across a wide range of behaviors (61, 88, 107, 140).

Some investigators have found that while the TTM has applicability for many categories, there is considerable stage specificity across multiple health behaviors (88). While individuals may progress through the same stages of change for a certain health behavior(s), Herrick et al. (88) reported that, when evaluating four health behaviors simultaneously, people were in different stages for each behavior. One may be in preparation for exercise, action for diet, contemplative for using sun block and maintenance for smoking. This is significant for health promotion practitioners because individuals at each stage of change possess differences in terms of decisional balance and self-efficacy. In other words, each stage of change is associated with its own attributes of attitude and perceptions. Although the work was limited by using convenience sampling and self-reporting methods, it provided some evidence that there is stage specificity across multiple health behaviors. Ultimately then, researchers and practitioners must be

sensitive to these differences, and ensure provisions are in place to account for stage diversity when applying the model to promote change in two or more health behavior cases.

Although considerable research has been accomplished using the TTM in smoking cessation and other addictive behaviors, there are growing numbers of studies that use the model for dietary and physical activity modifications (151). Many studies have established the connection between physical activity, diet and health promotion (12, 34). In spite of the vast body of dietary and exercise information, most Americans are not sufficiently motivated by this knowledge to affect dietary and physical activity habits (106, 167). Perhaps one way to effectively persuade individuals to modify their negative habits is to tailor this information according to their mental state of readiness to change. In essence, use the TTM to prompt change in the unaware/skeptic with motivational information and facilitate/sustain action in the committed with specific skills to practice. The ensuing discussion clarifies the particulars in which the TTM can be employed in transforming negative diet and physical activity patterns.

Applying the Transtheoretical Model to Nutrition

For the last two decades, the *Dietary Guidelines for Americans* (11) and the *Food Guide Pyramid* (2) have provided essential nutritional guidance to the general public. Despite various means to educate consumers, America's dietary habits are still in need of improvement (12). Recent efforts to influence consumers have evolved from understanding individual meal practices as well as attitudes and beliefs toward fruit, vegetable and fat intake. Some researchers feel that knowing the pattern in food

consumption by meal and day of the week may provide insight to better target audiences (24). This particular study found in a group of grade school teachers that breakfast had the lowest level of fruit consumption and that weekday lunches had more vegetable and fruit intake than on weekends. Brug (36) looked at eating practices and psychosocial factors and whether they differed across the stages of change for fruits and vegetables. This group determined that those in precontemplation are more likely to be affected by messages which influence attitudes whereas those in contemplation and preparation are more affected with self-efficacy information to increase confidence in overcoming barriers for consumption. Consequently, understanding the variables that impact food choices and implementing current research for changing health related behavior are key elements for successful dietary interventions (71).

Health behavior investigators are closely examining social and clinical psychology theories with which to better identify dietary behavior. The TTM is one type of theory that has attracted the attention of the nutrition community (73). In recent years, various researchers have successfully found the TTM to be linked with dietary patterns for intake of fat (38, 55, 72, 79), fiber (72), fruits and vegetables (72, 109). In a review article (101) by Kristal and colleagues, reported that the stages of change model is effective as a venue for aiding people to adopt more healthful diets. Authors mention that one should not confuse the TTM with measuring nutrient intake or dietary behavior. Rather, the model measures what individuals think about their diets and their intent to change. Secondly, healthful eating is a different behavior from those uncontrollable behaviors such as smoking or drug addiction. It is critical to translate or modify the TTM for optimal use in dietary interventions. Ni Mhurchu et al. (139) points out the

complexities involved in using the TTM in a dietary setting. In smoking cessation, the change assessment is more straightforward in that one measures the discontinuance of a particular behavior. Whereas in dietary change, the behavior is continued but is modified in some aspect as in increasing fruit and vegetable intake or reducing fat consumption. Further, it is possible that one particular dietary change has been made and adopted (in maintenance for fat reduction in diet) but now the realization may be to increase more calcium in the diet. Thus it is possible to incorporate very complicated and time consuming processes when considering dietary changes.

Lastly, Kristal and colleagues (101) argues that insufficient work has been done using the other constructs of the TTM, i.e., closely evaluating the validity of the processes of change or decisional balance for changing dietary habits. Can behavioral processes like counter-conditioning, stimulus control or social liberation be enough of an influence to move or keep people in the latter stages? As before, researchers emphasize that, if staging algorithms are valid, one can foresee the variances in dietary behaviors between individuals put in the various stages of change. It is at this critical juncture nutritionists can provide for and implement the requisite interventions to bring about successful adoption of healthful eating behaviors. Table 2.1 illustrates a general guideline provided by Kristal and co-workers (101) in applying the stages and processes of change towards adoption of healthful diets.

Creating a stage of change classification system to ascertain those who have adopted the behavioral changes necessary to meet the dietary guidelines is another important consideration when using the TTM for dietary interventions. Auld et al. (19) pointed out inconsistencies in earlier studies which reported individuals in action and

TABLE 2.1. General Guidelines for Applying Stages and Processes of Change to Adoption of Healthful Diets.*

State of Readiness	Key Strategies for Moving to Next Stage	Treatment "Do's" at this Stage	Treatment "Don'ts" at this Stage
Precontemplation	Increased information and awareness, emotional acceptance	• Provide personalized information • Allow client to express emotions about his/her disease or about the need to make dietary change	• Do not assume client has knowledge or expect that providing information will automatically lead to behavior changes • Do not ignore client's emotional adjustment to the need for dietary change, which could override ability to process relevant information
Contemplation	Increased confidence in one's ability to adopt recommended behaviors	• Discuss and resolve barriers to dietary change • Encourage support networks • Give positive feedback about a client's abilities • Help to clarify ambivalence about adopting behavior and emphasize expected benefits	• Do not ignore the potential impact of family members, and others, on client's ability to comply • Do not be alarmed or critical of a client's ambivalence
Preparation	Resolution of ambivalence, firm commitment, and specific action plan	• Encourage client to set specific, achievable goals (e.g., use 1 % milk instead of whole milk) • Reinforce small changes that client may have already achieved	• Do not recommend general behavior changes (e.g., "eat less fat") • Do not refer to small changes as "not good enough"
Action	Behavioral skill training and social support	• Refer to education program for self-management skills • Provide self-help materials	• Do not refer clients to information-only classes
Maintenance	Problem-solving skills and social and environmental support	• Encourage client to anticipate and plan for potential difficulties (e.g., maintaining dietary changes on vacation) • Collect information about local resources (e.g., support groups, shopping guides) • Encourage client to "recycle" if he/she has a lapse or relapse • Recommend more challenging dietary changes if client is motivated	• Do not assume that initial action means permanent change • Do not be discouraged or judgmental about a lapse or relapse

*Table from Kristal et al., (1999).

maintenance stages for low fat consumption practices, yet in actuality had intakes in excess of the recommended ceiling of 30 percent of the calories as fat. Investigators contend it is critical to categorize individuals correctly before intervening. Using a questionnaire that assessed perceptions, attitudes and beliefs and objective measures related to the dietary behavior, Auld and his coworkers were able to more accurately stage individuals. They argue that staging people by only their behavior and not their intentions or attitudes disregards the central constructs of the Transtheoretical model. In their results for fat and fiber consumption, they found far fewer individuals classified in action/maintenance and greater numbers in precontemplation in comparison to other research. Their comprehensive algorithm provided data that more closely matched the proportions of adults that practice low fat diets over that of previous research.

Lechner et al. (109) studied two methods of classifying stages in fruit, vegetable and fat intakes in Dutch populations (mostly male). Her group used a more objective means of discriminating between stages by including a description of the Dutch dietary guidelines for action/maintenance stages. By providing a more objective means of assessing their intake (i.e., were they eating the prescribed number of servings for the three nutrient groups?), clients were less inclined to misclassify themselves in action or maintenance versus preparation or contemplation.

Greene (79) proposed that it is critical to use all aspects of the Transtheoretical model (stages, processes of change and decisional balance/self-efficacy). Properly classifying a precontemplator, then using the correct experiential processes such as consciousness raising, self-reevaluation and dramatic relief and focusing in on the pros of change will be the most effective means of moving precontemplation to contemplation.

In other words, it would be just as self-defeating as improperly classifying an individual's stage as it would not using all the dimensions of the Transtheoretical model in the proper order. Practitioners are more likely to succeed with dietary feedback by ensuring the all aspects of the TTM are used (self-efficacy, decisional balance, processes of change).

Some studies have limited themselves to studying one or few components of the diet when assessing change. In 1992 (55), and in 1996 (108), research corroborated previous TTM diet studies where one observed the decrease in percent calories from fat as subjects moved from precontemplation to maintenance. Lamb and Joshi (108) reported that while the Transtheoretical model can account for fat reduction in the diet, not all the change processes discriminated individuals between different stages. Self-reevaluation and helping relationships were not as effective as consciousness-raising and self-liberation in selecting individuals between stages. It was suggested that possibly not all of the change processes work for dietary fat reduction as in the other type of health behaviors. Most authors agree, however, that it is important to validate what individuals ascribe to in terms of fat intake. In 1994, Greene (79) developed an algorithm that effectively characterized people as meeting recommended fat intakes of 30 percent or fewer calories. Using a set of questions as behavioral markers in addition to staging individuals, researchers were able to more accurately identify those who were truly in action and maintenance and those who were not. While limited to predominately middle class whites with above average education levels, it was valuable from the extent of correctly identifying stages to avoid mismatches.

In 1998, Greene and Rossi (76) extended this research when they looked at stages of change for fat reduction over 18 months using the above behavioral markers for

validation and evaluating the usefulness of feedback reporting. Because of the number of studies that were of limited duration and that those in precontemplation are not likely to take action in six months, Greene extended the study to a year and a half. It is also known that most feel they are in compliance with current dietary guidelines or at least limiting/avoiding high fat foods (55, 77, 79). Additionally, most individuals with high fat intake are just as likely to wrongly estimate their actual fat intake as well (78). Using individualized dietary feedback may aid individuals in accurately assessing their fat intake and effectively meeting established dietary guidelines. The concern is that in a large public setting, this individualized feedback may become too expensive and time consuming. Yet some limited feedback may be of value. As in his earlier research, Greene (76) found that his stage of change algorithm was effective in accurately staging individuals. True maintainers were classified as such when they perceived they were avoiding fat and had fat intake less than/equal to 30 percent of total energy at both 12 and 18 months. Greene further underscored the need to use experiential processes for earlier stages (precontemplative and contemplative) and behavioral processes for the later stages (preparation, action and maintenance). Interestingly, the sole feedback report given at one year did not appear to be of any use in promoting further fat reduction in the diet. The authors suggested that more than one instance of feedback be given to see any effect over time. As in his earlier study, the study sample was not representative of the general population. The test subjects were predominantly white, fairly well educated, but evenly distributed by gender.

A growing body of evidence from numerous studies (55, 72, 79, 106, 170) indicates the usefulness of the TTM in effecting change in fiber, fruit and vegetable

intake in addition to fat intake. Two large prospective studies, *Working Well Trial* (17) (n=17,121) and *Next Step Trial* (176) (n=5,042) in the 1990s, looked at the efficacy of the TTM in affecting the dietary patterns of all four components at the same time. Glanz et al. (72) in research connected with the *Working Well Trial,* determined, in 1994, that the TTM was associated with fat, fiber, fruits and vegetable intake in a stepwise, predictable manner. The group also determined that the TTM helped explain more of the variability in dietary intake than did the demographic variables like age, gender or education. Additional follow-up research (70) in 1998 corroborated results from her earlier research (72), and in addition, found that the TTM was associated with adoption of healthful diets, i.e., those in a later stage reported higher interest and participation in practicing healthier eating habits. Tilley et al. (175, 177) studied consumption patterns of fruit, vegetables and fat in male autoworkers at risk for colorectal cancer. Using tailored educational materials based on the TTM and social cognitive theories, investigators were able to show significant results for decreasing fat intake and increasing fiber, fruit and vegetable intake after one year. Both of these large studies had predominately male subjects, between the ages of 30 to 50, possessing at least a high school education and/or some college education.

Further research (47) on the national 5-a-day campaign across 8 states in various regions uncovered TTM association with awareness of the 5-a-day campaign. Fruit and vegetable consumption, self-efficacy, and knowledge of the campaign recommendations were all positively associated with more advanced stages of the TTM. The study used mostly women, but one study site (predominately male) gave similar results as found in the other remaining studies.

Applying the Transtheoretical Model to Physical Activity

While positive dietary changes are paramount to good health, there is considerable evidence that exercise is just as important (6, 144, 171). In a major review by Blair et al. (28), the authors point out the myriad of beneficial outcomes of exercise in preventing or aiding those with various disorders such as coronary heart disease, diabetes, hypertension, and osteoporosis. Favorable effects thought to be of importance include improved glucose tolerance, reduced free triglycerides, high HDL levels, low LDL levels, reduced hypertension and anti-atherogenesis. These are all brought about by physiological and biochemical changes on muscle fiber type, capillary density and substrate utilization (105). Other than its obvious effects on energy balance and weight maintenance, physical activity is thought to have its best effect in maintaining fat free mass, which is major metabolic player in fat utilization in the body. Subsequently, exercise is also closely examined along with diet as a means of health promotion.

Hillsdon and Thorogood (90), in a 1996 review of physical activity promotion strategies in the U.K., found that best results were with interventions that had regular follow-up. When health care providers or their staff made efforts to follow up on their patients' progress (either through phone or mailings), higher compliance rates with exercise were found. There are other key determinants of physical activity that have been elucidated in the literature (95, 122) and are generally categorized into three groups: personal characteristics, psychological variables and environmental factors.

King et al. (95) report in a review that African-American women, the less educated, overweight individuals, older adults and physically challenged individuals are less likely to be active than others. In terms of psychological aspects, King and co-

workers also advised that self-efficacy, self-motivation, health perception, perceived benefits of exercise and exercise enjoyment are key variables that are well related to higher levels of physical activity in both men and women. Decisional balance has also been an instrumental element of physical activity participation. Those who can determine for themselves the positive aspects associated with increased physical activity are more likely to exercise on a routine basis (125).

Family influences as well as access and proximity to local fitness and recreational facilities are mainstays of environmental factors for physical activity participation. Raglin and Wallace (154) showed that those who work out along with their spouse have higher rates of compliance with exercise regimes than those who do not. Sallis (165) advised that safe and convenient community recreational facilities are an important factor on exercise participation. Additional determinants of physical activity are gender differences (179) and perception of health-related quality of life (107). Using mailed surveys to reach male and female school district employees, Troped and Saunders (179) evaluated differences of social influence on exercise that may occur between genders in various stages of exercise adoption. They found gender differences with regards to social influence for exercise adoption. Social influences such as friends, family, physicians, and co-workers were of more importance to inactive women in terms of motivation than was found in inactive men. However, researchers reported no gender differences for social influence on exercise adoption, when men and women both were in more advanced stages for exercise behavior (action, maintenance). LaForge's research (107) focused on stages of exercise and one's perception of health-related quality of life. Using a random digit dial telephone survey technique and an instrument that measured multidimensional

aspects of health-related quality of life (mental and physical health), LaForge's group determined exercise stage is a correlate of self-perceived quality of life. Generally, it was found that those with the lowest perception of vitality and physical functioning were those in the earlier stages of exercise adoption (precontemplation and contemplation). Researchers (107) point out that healthcare providers who plan interventions for the sedentary should use these data to devise targeted messages which emphasize the improvements in quality of life from increased physical activity. Interestingly, some (65, 156) report that if the cost of being sedentary increases or if access to the sedentary lifestyle is blocked or made difficult, individuals will increase their activity.

Various researchers have scrutinized lifestyle physical activity interventions, which have effectively increased activity levels in both sedentary children and adults. Dunn's (62) review of 14 studies revealed that, in general, these interventions successfully used a variety of behavioral change theories to modify activity levels in individuals. While the review shows that face-to-face contact with the target population was used in the majority of the studies, some indicated other dissemination methods like mailings or computers could be used to practically reach a much larger range of individuals than earlier thought (48, 114, 121). In fact, Dunn and associates posit that future lifestyle interventions should be integrated and delivered via new technologies such as through interactive computer programs or web-based formats.

Marcus et al. (119), in a 1996 review of promoting physical activity with varying theoretical models, discovered that no one particular model sufficiently explains exercise behaviors. Yet some of the common themes for a successful intervention are addressed in the Transtheoretical model.

These include (119):

- Enhancing the perceived benefits of physical activity
- Enhancing self-efficacy
- Increasing enjoyment of physical activity
- Increasing intentions to exercise
- Enhancing social support
- Including moderate intensity activity

There is substantially more research done in the cessation or addictive behaviors regarding the Transtheoretical model than with positive desired behaviors like exercise and diet. Yet, recent research (44, 51, 107, 121, 128, 138) has shown strong applicability for exercise as well. In 1992, Marcus and her group (125) were one of the first to show how the Transtheoretical model had promise in the adoption of a positive acquisition behavior such as exercise. Researchers developed and then implemented a "Process of Change" questionnaire that was then used to survey both male and female employees from two different worksites (white- and blue-collar positions). Results showed that subjects could be categorized among the five different stages of change for exercise adoption. Further, subjects used all ten processes of change formerly employed in cessation behaviors, and that those in precontemplation apparently did not require as many of the processes to change as compared to those subjects in the action and maintenance stages.

Nguyen et al. (138) reported using two theoretical models in further clarifying factors associated with exercise adoption in men aged 30-60 years of age. Interestingly, the researchers combined tenants of the Theory of Planned Behavior with constructs of the Transtheoretical model. Nguyen argued that one must take into consideration the intention of performing a behavior as well as the perception of controlling it. Further, as exercise is a physical behavior, one should also consider the actual behavior behind the intention (Transtheoretical Model). Using both models, Nguyen and colleagues were able to more effectively identify the various subgroups of targeted males for a specific intervention. Regression analysis showed that variables from the Theory of Planned Behavior were differently associated with the Transtheoretical model, depending on the stage. Although significant in their results, it should be indicated here that the Transtheoretical model does, in fact, take into account aspects of the Planned Behavior Model (consciousness raising can be used to improve attitudes, helping relationships to change subjective norms, and self-efficacy to increase perceptions of behavioral control). It is unclear why the authors did not consider these as already being incorporated in the Transtheoretical model.

Correctly categorizing the stages can also be important when applying the Transtheoretical model. Cole (51) used federal employees as test subjects in an application of the Transtheoretical model in a worksite situation. They reported that the TTM can serve as a gauge for the behavior change process and can be used as a means of evaluating short-term effectiveness of physical activity programs. Investigators also reported that a fair amount of change occurred within the preparation stage, split into two categories (preparation and late preparation). Although the model is typically considered

to have five stages, some (125) have reported a stage in between preparation and action known as "late preparation." Due to the numbers of individuals reporting within a category that is not yet considered action in some studies (moderate physical activity less than five times per week or vigorous exercise less than three times per week), another stage was added to further draw distinctions between true "action" and "preparers." Cole found the same results in a similar population of government workers although it was not clear whether individuals would have classified themselves into a sixth stage (late preparation) if it were not made available (51). No other studies reported using a sixth stage other than the aforementioned.

Marcus and Simkin (128) explicitly stress that the four main constructs of the Transtheoretical model be applied towards the modification of exercise behavior. As mentioned in the beginning descriptive section of the Transtheoretical model, the stages of change categories, the processes of change, decisional balance, and self-efficacy constructs must be incorporated to effectively impact behavior modification towards exercise. As Marcus points out in her paper,

> "A particular strength of applying the Transtheoretical model to the study of exercise behavior rests in its dynamic nature...In accordance with its dynamic focus the Transtheoretical model suggests that behavior change is not an all-or-none phenomenon and that individuals who stop performing a behavior may have intentions to start again." (128)

One of the main constructs of the Transtheoretical model, self-efficacy (confidence a subject has to perform a new behavior), has been closely examined by McAuley et al. (131, 132) for its pertinent value in exercise adoption and adherence. In earlier research (131) in 1992, using sedentary middle-aged men and women, McAuley tested two models (general and specific) that predicated self-efficacy perceptions as part

of two characteristics of exercise behavior, frequency and intensity. Results indicated that self-efficacy was instrumental towards aiding in the early stages of exercise adoption but less so in the maintenance stages. Rather, the habitual activity or regular exercise routine played a much stronger role as a predictor of exercise responses.

In 1994, McAuley and his group (132) evaluated the validity of using an intervention based on self-efficacy. Once again using sedentary, middle-aged individuals, the group determined that self-efficacy played a significant role in predicting exercise behavior. Although a direct effect of self-efficacy was not found due to the possibility that the intervention may have impacted other aspects of exercise behavior (changing attitudes towards participation in exercise), the intervention content clearly made an impression on individual exercise behavior in the earlier adoption phases. The drawbacks to these studies were only using low to moderate impact style of aerobics such a walking or recreational swimming instead of more intense activities. It would be of interest to see if these results would hold true for more demanding activities such as jogging, running, cycling or lap swimming. An important point to recall about self-efficacy is that according to Bandura (22), "self-efficacy is not concerned with the actual skills that an individual possess, but rather the individual's judgment of what he or she can do with those skills."

Applying the Transtheoretical model to a worksite setting has been one of the challenges health professionals have undertaken to reach more at risk populations. Three recent studies (44, 121, 146) have demonstrated the Transtheoretical model has suitability for both corporate and blue-collar business environments. Peterson and Aldana (146) divided participants into three groups; those who received stage-based materials, those

who received standard generic materials (information from the American Heart Association), and those who did not receive any materials whatsoever. Overall, those who had the stage-based materials mailed to them had an increase of 13 percent in physical activity, while the other two groups saw no change or an actual decrease in physical activity over the study period. Interestingly, when asked if they (the employees) had actually read the materials, 92.5 percent of those in the stage-based materials group said they had, as compared to 79.3 percent in the standard generic materials group.

Burn's group (44) examined British government office workers to ascertain the relationship between an individual's motivational readiness to adopt exercise as expressed through the Transtheoretical model and coronary heart disease risk factors. They found body mass index (BMI), aerobic activity levels, dietary habits, self-efficacy for exercise, stress and age all differed significantly across the Transtheoretical model stages for exercise adoption. Researchers (especially for age), found that the older and more sedentary individuals were found to be in the earlier stages (precontemplative, contemplative), whereas the younger participants were more likely to be in the latter stages (preparation, action and maintenance). Marcus (121) investigated workers from a subset of a larger health research trial (17) and found that printed self-help materials motivationally tailored to the individual rather than standard self-help materials resulted in more advancements to the latter stages of change. Their study also showed that those receiving the motivationally tailored materials were also less likely to remain static or to regress to an earlier stage.

Although previous studies have successfully shown applicability of the Transtheoretical model towards physical activity, most of the data were collected by

self-report measures. Validating self-report data with physical objective measures could strengthen future studies. Cardinal (49) initiated a descriptive cross-sectional study which determined the degree of association among the stage of exercise and seven different variables (BMI, VO_2 max, exercise type, exercise index, relapse, barriers, and self-efficacy). After controlling for several confounding factors (age, social desirability of the exercise behavior, etc.), Cardinal found that, consistent with the model, all seven variables improved as one progressed along the stage continuum and that they were all significantly associated with the stages of change construct. Further, significant associations were found between the stages of exercise and age, marital status and ethnicity and less so with education, gender and income levels. Although the study was flawed by a number of limitations (cross-sectional design, self-select population, predominately female and Caucasian), it drew out the importance of using various biometric, behavioral and psychological markers to validate self-report data in TTM studies.

<u>Information Technology for Promoting Positive Diet and Exercise Behaviors</u>

At present, there are few health behavior studies that have incorporated personal computers and web-based intervention programs. The potential, however, exists to make more effective use of health professional's time and resources by reaching a much larger target audience in shorter time. The explosive growth of the Internet and the affordability of home computers have immeasurably enhanced the means by which people are now informed. Additionally, nearly all white-collar worksites have computers installed for each employee, providing yet another avenue for health promotion efforts.

Dirkin (60) offers that technology such as computers and web sites can supplement or even replace counseling or social support systems for exercise adherence interventions. He argues that computer programs can provide the immediate and frequent feedback so often desired by intervention participants who are working toward certain goals. Dunn (62) suggests more study be devoted to evaluating the effectiveness of lifestyle interventions disseminated by "interactive computer-mediated, telephone or computer web-based formats." Considering the busy lives in today's society, the ease and accessibility to health information or assistance 24 hours a day would be very appealing to most individuals.

Marcus (121) posits whether using web sites to disseminate information in a tailored, personalized fashion would be effective enough to influence behavior. In a review (121) of physical activity interventions using mass media technologies, it was reported that, although mass media messages had little impact, other studies which had follow-up contact and tailored information for the target audience were more successful in the long term. Reviewers suggested further controlled studies using media-based technology such as interactive web sites to deliver tailored information. Marcus suggests this research should explore where this type of technology would be most effective, such as in the home or at work (through the worksite Internet setting). In light of the rising U.S. population levels of sedentary individuals, Marcus (120) makes the case for moving beyond face-to-face programs to use of newer technologies like the Internet. In order to reach more people in shorter periods of time, interactive communications probably represent the best strategy, in the near term.

Most of the literature references pertaining to use of information technology in health promotion have primarily involved "computer-tailoring messages." Computer tailoring according to DeVries and Brug (57) is "the adaptation of health education materials to one specific person through a largely computerized process. Tailoring refers to the fact that the content of the information is adapted to an individual's characteristics (gained through surveys and questionnaires)." Kreuter (98) feels that printed tailored materials from computers probably offer the greatest promise for health education and behavior change for the future. The capability to extract client information and then expediently provide feedback (which is matched to the individual needs) is not only feasible but is quite practical in today's technological environment.

Developing materials which are tailored to an individual is an intricate process composed of four main parts: 1) "determining" a person's specific characteristic for a certain behavior; 2) creating a "source file" of health messages that contain all the relevant information needed to effect a behavior change; 3) providing a "measure or instrument" which properly categorizes an individual to receive an appropriate message for their readiness for change; and 4) deciding on the "means of dissemination" of the message via mailed letters, classroom setting or use of computer technology via the Internet.

DeVries and Brug (57) point out several reasons why tailored messages, especially those using computer technology, are potentially more effective. They include personalization of the message suited to the individuals needs, more likely to be read and retained for future use, less repetitive and general type of information and more cost effective in terms of reaching out to larger segments of a target population. Further

advantages include flexibility to respond to an unanticipated change in an individual's behavior, and most importantly, providing an interactive and private means for individuals to seek assistance on more sensitive health promotion areas such as sexually transmitted diseases, alcoholism or birth control. A review of eight studies (35) that evaluated the utility of using computer-generated and tailored messages to promote healthy lifestyles revealed a greater effect over standard health information materials. Authors point out that these technologically-based interventions resulted in individuals reading and retaining more information than conventional standard materials (i.e., three ring notebooks filled with general type information).

While considered a promising and potentially unique method in health behavior change efforts, there are a number of aspects of this technique that require further elucidation. For example, one concern deals with the length of the message content. Some research (46) used only a couple of printed pages whereas others (37) have had more material to read. What is the most effective range and when does it become burdensome? Repetitive feedback is another area that requires exploration. Brug et al. (37) had significant results when using iterative and tailored feedback material to impact fat, fruit and vegetable intake. It is unclear by what mechanism the iterative feedback has its effect (repetition of the message itself or the actual tailoring of the message which conforms to the current needs of the individual changing behavior). Most of the populations studied were considered to be highly educated, which further raises the question of utility in lesser educated, lower socio-economic status. Additionally, there are various cognitive aspects of behavior change which seldom act in isolation.

Newer research in computer-tailoring needs to consider the myriad of processes one uses during a behavior change as indicated by Prochaska and DiClemente (148). Their research with smoking cessation programs revealed that individuals can use a number of cognitive strategies such as self-efficacy, weighing pros and cons, seeking support from others, or self-assessment to aid themselves in changing to a positive behavior. Use of various types of media to disseminate the message should also be encouraged. Technology such as touch-screen kiosks, interactive CD-ROM programs and the Internet should be explored as means to spread the messages. Lastly, the majority of the studies reviewed dealt with only one behavior. Current research efforts should study the potential for changing two or more behaviors at the same time. People who exhibit unhealthy lifestyles seldom practice only one negative behavior. To illustrate, a person who is sedentary may also have problems with adopting positive dietary habits or smoking cessation efforts.

As determined from earlier research, (39, 59) several important components are required for successful implementation of computer-tailored interventions: 1) determine the intervention objectives based on the study of the factors related to the behavior change, 2) selection of suitable staging algorithms in which to categorize subjects to receive appropriately matched information, 3) careful development of the nutrition and physical activity newsletters, materials, e.g., which are tailored to every possible stage, and 4) incorporation of an advanced computer program which can effectively and expediently match an appropriate newsletter to a staged reader. Rhodes (159) mentions a number of behavior theories that are available for use with computer-tailoring health education. The TTM is included among these theories because the model contains

constructs, which consider intention to change, costs/benefits of change, and self-efficacy aspects of the anticipated change.

Early computer-tailoring efforts with the use of the TTM began in a primary care setting in 1991. Campbell et al. (46) studied four family practice populations using a dietary intervention. Researchers were interested in observing any change in fruit, vegetable and fat intake when provided computer-tailored information based on a stage of change approach. While Campbell and colleagues did not see significant results for fruit and vegetable intake, they did have significant dietary fat reduction. Researchers also found study participants receiving tailored information were twice as likely as those not receiving tailored information to recall the information they were given and to have read all the material completely. Brug (39) and Kreuter (97) followed in 1996 using a combination of behavior theories and computer-tailoring to impact dietary intake. Brug (39) reported Dutch participants were more satisfied with the tailored information and more often self-reported to have made changes in their dietary habits. Fat intake was significantly reduced while fruit and vegetable intake increased, but not significantly so. Kreuter and Strecher (97) also did research in a primary care setting using screening procedures as an opportunity for promoting change. Here researchers used health risk appraisals in both a tailored and non-tailored format as an education tool. Results shown that a tailored health risk appraisal promoted changes in cholesterol screening, fat consumption and physical activity, but not in smoking, seat belt use, mammography and Pap smears.

Lutz et al. (112) found similar results in four U.S. HMO samples. Sending out three different styles of newsletters (non-tailored, computer-tailored, and tailored with

tailored goal-setting information) on increasing fruit and vegetable intake, tailored newsletters were also found to be effective over controls not receiving any information. However, Lutz did not find any significant difference between the three types of newsletters in that all had resulted in dietary changes of nearly equal magnitude. This may have been the result of only sending out one message per month for a period of four months. Because part of the theoretical framework included the TTM, a longer period of time should have been allotted to permit earlier staged individuals to advance. Contemplators need a minimum of six months to consider change before moving to a shorter term commitment (151) and it may be possible two or more messages are needed on a monthly basis. Lutz did report that subjects who received the tailored goal setting newsletters were more likely to recall getting newsletters than the other groups.

Brug (37, 39, 40) has done considerable research using computer-based technology with the TTM, albeit in Dutch populations. In 1998 and 1999, Brug and colleagues evaluated the impact of adding iterative feedback over a longer time period (37) and whether additional psychosocial information enhances tailoring (40). When both initial and repetitive feedback was given to subjects in a tailored fashion, dietary change was found to be impacted at a significantly greater level than found with those who only received initial tailored feedback or controls (37).

In the 1999 study (40), supplying additional feedback tailored to attitudes, perceived social influences and self-efficacy made no difference between groups. Brug speculates that the longer length of the tailored messages that included psychosocial information may have weakened the overall content that encouraged change. It may also be possible that some of this additional cognitive information may not be of relevance in

the sample tested (predominately female, with lower education levels) versus other groups with demographic differences (41). Interestingly, as found in his earlier research, both groups had significant changes in dietary fat, fruit and vegetable intakes after receiving tailored information.

Computer tailoring studies thus far have been limited for promoting physical activity behaviors (42, 43, 97). Bull (43) studied the effect of computer-tailored messages in increasing physical activity in a mixed population of middle-aged adults in the U.S. Previous research (42, 97) revealed mixed results comparing standard and computer-tailored materials to promote increased physical activity.

Bull and colleagues sought to evaluate the effects of computer tailoring on both physical activities of daily living (gardening, housecleaning, etc.) and leisure type activities (strengthening, aerobics, sports, etc.). Investigators found significant differences between those who received standardized materials and computer-tailored information for physical activities of daily living, but found no differences between groups when leisure type activities were promoted. While the researchers posit that efforts to increase physical activity may not be always feasible with computer tailoring, they express the possibility of overlooking one important consideration—the need to uncover what particular determinant of behavior change (e.g., motivator or barrier) is relevant to an individual. In other words, taking into consideration which of those processes of change (148) is beneficial in helping a person transition to a healthier lifestyle. With physical activity, "lack of time" is often a strong barrier to increasing one's physical activity. Bull and her group attempted to overcome this barrier in the tailored messages but found their message was quite similar to that recommended in the

standard materials, and as a result, was ineffectual in fostering additional change over that of usual care. Researchers remarked that a lack of time can mean different things to a variety of people (businessman versus a homemaker with three children) and that one should consider a variety of solutions to a particular barrier, not just a few. Other limitations reported by the group included eligibility screening methods which excluded a portion of subjects that were overweight or had high blood pressure. These individuals, although considered a health risk for the physical activity intervention, may have provided a more dramatic difference for levels of significance. On the other hand, the resultant healthier study population showed improvement, but at lower, statistically insignificant levels. Study measures to assess physical activity were also limited in that they did not capture all types of leisure or daily living physical activities, thereby possibly missing important increases in physical activity due to the tailored information. Bull et al. suggested future research with tailoring messages to increase physical activity should both identify and incorporate the social, psychological and environmental aspects with regards to behavior change in individuals.

More recently, Gould and Anderson (75) evaluated the effectiveness of an interactive multimedia health promotion program in Hispanic populations. Using nutrition education materials based upon the TTM from an earlier study (174), researchers developed a touch-screen computer system in an enclosed kiosk. Although designed for low-income Hispanic persons and migrant farm workers in southern Colorado, the program was found to increase nutrition knowledge and decrease dietary intake of salt. Participant surveys revealed the majority who used the interactive computer program and liked using the touch screen felt "the touch screen was easy to

use, pictures made sense, and the program was user-friendly." While the investigators recommend this mode of information dissemination as a practical health promotion tool, they emphasize it is not a substitution for qualified health professionals. Rather, it is a flexible, accurate and effective instrument to reach greater numbers of at-risk populations.

Nutrition and Physical Activity Outcome Measures

The majority of the research done with the Transtheoretical Model (TTM) provided results from self-reported or research investigator led surveys (37, 39, 43, 46, 55, 113, 117, 175). While previous TTM research has been successful in changing self reported behaviors, advocates of the TTM have called for more objective verification of results (69, 88, 117, 118). Cardinal (49) investigated the validity of the stages of change construct (from the TTM) through more objective data such as body mass index (92) and cardiorespiratory fitness (136) values. He found subjects did differ among the five stages according to the level of fitness and BMI. Those with greater fitness levels and lower BMIs staged themselves in action and maintenance while those less fit and with higher BMIs categorized themselves in the lower stages. Hausenblas et al. (85) did a similar study with objective and self-report measures. Also using VO_2 values from cycle ergometry protocols, she reported differences in fitness levels between the stages. Persons who were categorized in higher stages of change had greater endurance than those at the lower stages.

This intervention study used aspects of the aforementioned research in concert with other objective parameters to substantiate intervention effects. The ultimate

objective of the intervention was to improve fitness levels in enlisted male personnel through changed diet and physical activity habits. Studies have shown the importance of both diet and physical activity in promoting good health and fitness (28). Consequently, both behavioral and physiological assessments were obtained to fully study intervention effects. A further explanation of the specific data collection follows.

Behavioral Data Collection. There are multiple ways available for assessing self reported nutrient intakes. As in most situations, there are benefits and drawbacks to each. Although some research has shown that the 24-hour dietary recall is among the most accurate, it is time consuming and labor intensive (45, 67). The food frequency questionnaire (FFQ), while not as accurate, has seen increasing use from its initial implementation in the 1960s (133). These instruments are especially useful from the standpoint that they provide a measure of a person's "usual intake" of a variety of foods over time. This is particularly valuable information when appraising the relationship of one's diet to the risk of some chronic disease over the long term (143). This is of particular interest because of intervention efforts to promote increased fruit and vegetable intake on a daily basis, over time.

FFQs have been successfully implemented in a variety of dietary studies, especially those involving the TTM (47, 55, 72, 79, 109). One of the major drawbacks with surveys concerns participant burden and response rate. As the survey becomes longer and more complicated, completion rates drop fairly quickly (143). Kristal et al. (102) devised a short FFQ survey which targeted both core and secondary core foods related to fat and fiber. Additional research in 1992 (104) led to the creation of an even shorter 24-item tool that assessed dietary behaviors related to the selection of low fat

Gatorade Sports Science Institute

AMINO ACIDS, PROTEINS, AND EXERCISE PERFORMANCE

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Martin J. Gibala, Ph.D.
Department of Kinesiology
McMaster University
Hamilton, Ontario
Canada

Mark Hargreaves, Ph.D.
School of Health Sciences
Deakin University
Burwood, Victoria
Australia

Kevin Tipton, Ph.D.
Division of Metabolism
Shriners Burn Institute
University of Texas Medical Branch
Galveston, Texas

KEY POINTS

- In all but a few exceptional cases, the maximal contribution of protein as an energy source during exercise ranges between 2% and 10% of the total energy expended.
- In theory, amino acids could contribute to carbohydrate metabolism during exercise, but there is no hard evidence that this occurs or has any bearing on sport performance.
- Supplementation of the athlete's diet with branched-chain amino acids apparently does not benefit exercise performance.
- The most important factors for optimizing muscle growth when one trains with resistance exercise are making certain that the resistance is adequate, that the intake of dietary energy (calories) is sufficient, that at least a small amount of carbohydrate and/or protein is consumed immediately after each training session, and that the athlete obtains plenty of rest between training sessions.
- With rare exceptions, the maximal daily dietary protein requirements for athletes are in the range of 1.2-1.6 grams of protein per kilogram of body weight or about 3-4 ounces of protein per day for an athlete who weighs 160 pounds. This amount of protein can almost always be obtained in the normal diet.
- There is no solid evidence that special mixtures of amino acids provide any advantage over normal dietary proteins in stimulating muscle growth.

INTRODUCTION

For many years, experts and non-experts alike have been debating the question of whether or not athletes, particularly those who wish to gain muscle mass, should consume extraordinary amounts of protein in their diets. Protein powders and special amino acid mixtures have held their places among the top sellers in the dietary supplement field for as long as most of us can remember. Athletes presumably spend hundreds of millions of dollars annually on protein shakes and flakes, but it is impossible to know for certain if these products have made any difference in their physiques or in the performance of their sports.

What contribution does protein make to the energy requirements for weight lifting compared to endurance running or cycling? Does the consumption of carbohydrate speed up the production of protein in muscles? How much protein do athletes in various sports need in their diets? Can this protein intake be achieved by consuming normal foods, or should athletes be ingesting protein supplements? Are proteins good enough, or is it better to consume specific mixtures of amino acids that are purported to markedly improve protein buildup in the muscles? We asked these and other questions to a panel of experts in amino acid and protein metabolism. Each of these respondents has had extensive experience with cutting-edge research in metabolism at rest and during exercise. (A few of their many scientific publications are cited at the end of this roundtable.) Moreover, each of the panelists has a background of athletic participation and thus appreciates the practical aspects of this topic.

1. How much of the energy expended during exercise of various types can be attributed to the use of proteins and amino acids as fuels?

Gibala: The majority of energy for all types of exercise is derived from carbohydrates and lipids. For short-duration exercise (e.g., sprinting or weightlifting), the contribution of amino acids and proteins to energy production is negligible, regardless of intensity. During more prolonged forms of exercise (e.g., endurance cycling or distance running), recent studies suggest that the oxidation of amino acids accounts for approximately 2-5% of the total energy expenditure. There are conditions during which the energy contribution from amino acids may be higher, e.g., when initial muscle glycogen stores are low, but the maximal energy contribution from protein sources during prolonged exercise is probably less that 10%.

Tipton: It seems to be dependent on the type and intensity of exercise. For endurance exercise, the estimates vary from 2-3% up to maybe as much as 10%. I'm not familiar with any estimates for resistance exercise.

Hargreaves: It is generally accepted that the contribution of proteins and amino acids to energy metabolism during exercise is relatively small. Depending upon the exercise intensity and duration, in addition to the nutritional status of the individual, this contribution varies between 3% and 10% of total energy expenditure.

2. Even if proteins contribute relatively little energy by themselves, does the breakdown of proteins to amino acids accelerate the production of energy from carbohydrates during exercise?

Hargreaves: Amino acids can participate in reactions that generate molecules involved in the metabolic processes that lead to oxidation of carbohydrates, and these reactions speed up during exercise. However, we still do not know if this potential involvement of amino acids has any bearing on exercise performance.

Gibala: The metabolism of amino acids certainly influences other metabolic processes, but, as Dr. Hargreaves has suggested, the significance of these interactions during exercise remains debatable. A notable example of this interaction occurs at the level of the tricarboxylic acid (TCA) cycle, which is a series of metabolic reactions that form a critical pathway involved in carbohydrate (and fat) oxidation. Several metabolic "intermediates" in the TCA cycle take part in side reactions involving amino acids; thus, the metabolism of amino acids can potentially affect the oxidation of carbohydrate. For example, the amino acid glutamate can be a key contributor to the rapid increase in TCA cycle intermediates that occurs at the onset of exercise, whereas the oxidation of leucine, another amino acid, may reduce the concentrations of TCA cycle intermediates during prolonged exercise. It has been suggested that these changes influence the capacity for aerobic energy production, but recent studies have indicated that changes in TCA cycle intermediates during exercise are unrelated to TCA cycle function. Thus, in the case of the TCA cycle, a theoretical argument can be made that amino acids influence carbohydrate oxidation during exercise, but there is no strong evidence to support this argument.

Tipton: There is evidence indicating that some of the amino acids make an important contribution by providing TCA cycle intermediates, without which aerobic metabolism may be limited. Still, the evidence on this score is incomplete, and I would not recommend ingesting amino acid supplements or proteins in the hope that they would noticeably accelerate carbohydrate metabolism.

3. What are the basic determinants of whether or not muscle size increases when one trains with resistance exercise?

Tipton: The primary stimuli for determining muscle growth are the resistance exercise training and the interaction of the training with food intake. There seems to be a certain threshold of intensity of exercise, below which no significant increases in muscle size will occur, perhaps due to a lack of stimulation of net muscle protein synthesis. Additionally, it seems that exercise that is too intense may inhibit protein synthesis, thus reducing the potential for muscle growth. It is also likely that insufficient rest will inhibit muscle growth during a training period. Although it is not yet clear exactly what diet composition best stimulates muscle growth, it is certain that muscle growth will be limited if insufficient calories are consumed. It is likely that minimum amounts of protein and carbohydrates are necessary as well, but what

these levels are has yet to be determined. Of course, the overall effect is constrained by one's genetic limits.

Gibala: There are many factors that ultimately determine the response of skeletal muscle to resistance exercise, but the essential determinants are: (1) the intensity of the loading, e.g., the weight lifted, (2) the nutritional state of the individual, particularly immediately after the exercise period, and (3) the duration of recovery between successive workouts. Application of the overload principle suggests that a training load of at least 60-70% of the one-repetition-maximum (1RM) is the minimal load required to stimulate muscle fiber hypertrophy. For most individuals, the optimal intensity (which corresponds to about 80% of 1RM for most exercises) is a load that can be lifted 8-12 times before failure. Post-exercise feeding is also very important. Ingestion of protein and/or carbohydrate during the 1-2 h period immediately following a bout of resistance exercise potentiates the effect of exercise alone in stimulating the buildup of muscle protein. Notably, a relatively small amount of food, e.g., the energy contained in 1/2 cup of yogurt or a typical sports energy bar, may invoke such a response. However, the research completed thus far has studied metabolism and the effect of protein feedings for only a few hours. There is a clear need for long-term studies designed to clarify the time course and the magnitude of changes in muscle protein metabolism and the impact of nutritional interventions on the rate of fiber hypertrophy over days, weeks, and months of resistance training and feedings. Finally, adequate recovery between training sessions is crucial because the tissue damage caused by resistance exercise may persist for 3-5 d in experienced weightlifters and much longer in persons who are just beginning a training program. As a general rule, it is wise to avoid working a muscle if there is residual soreness from a preceding day's workout.

Hargreaves: I concur with my two colleagues that the most important factors for optimizing muscle hypertrophy are choosing an adequate resistance load and consuming enough dietary energy. Protein and carbohydrate consumption are secondary to these two considerations.

4. How much dietary protein should an endurance athlete or a strength athlete consume on a daily basis? Can this protein intake be achieved on a normal diet, or are special protein supplements required?

Hargreaves: Strength and endurance athletes may need to consume 1.2-1.6 grams of protein per kilogram body weight each day (about 3-4 oz. per day for a 160 lb athlete), which is somewhat greater than the Recommended Dietary Allowance. On the other hand, there is some evidence that well-trained endurance athletes may actually use less protein for energy during exercise than do untrained individuals, which would have important implications for their dietary protein requirements. Still, because athletes typically increase their energy intakes during training, they should be able to obtain the protein they need from their ordinary foods and need not resort to special protein supplements.

Tipton: With the possible exception of athletes who are vegetarians, it is extremely unlikely that any athletes in Western countries would need to use protein supplements. There does not seem to be any evidence that a protein intake higher than what most athletes already consume is necessary, as long as energy intake is not too low. However, it is not clear exactly what the protein intake should be on a daily basis. Some studies suggest that protein intake should be higher than the Recommended Dietary Allowance of 0.8 grams of protein per kilogram body weight per day for both endurance and strength athletes. On the other hand, studies from our laboratory indicate that exercise may actually reduce the requirement for protein intake due to the stimulation of muscle anabolism by the exercise itself. This may explain how some endurance athletes, such as the Kenyan distance runners, can thrive on very low protein intakes. Athletes for whom muscle hypertrophy is important are not likely to be able to compete on intakes as low as some of the endurance athletes. I don't think there is a definitive recommendation that can be made with the information we currently possess.

Gibala: Even under the most extreme conditions, maximal daily protein requirements are unlikely to exceed 1.6 grams of protein per kilogram of body weight, and the vast majority of athletes consume ample protein to cover any elevated need. Studies have shown that on average, male and female endurance athletes obtain about 14% of their daily energy from protein, and the relative proportion for male strength athletes is 18%. For example, an active 70 kg individual with a daily energy intake of 3,500 kcal would typically consume at least 120 grams of protein every day. Here is how that calculation is made:

1. Daily energy intake x fraction of that energy consisting of protein = protein calories per day
Example: 3,500 kcal/d x 0.14 = 490 kcal of protein per day

2. Kcal of protein per day ÷ 4 kcal/gram = grams of protein consumed per day
Example: 490 kcal /4 = 122.5 grams of protein consumed per day

Assuming that this athlete is engaged in extremely intense training and has a daily protein requirement equivalent to double the RDA (70 kg x 1.6 g/kg = 112 g/day), this requirement is still met by the habitual daily intake. The only athletes who may be at risk for insufficient protein intake in their normal diets are those who consume too little energy (e.g., amenorrheic female runners; wrestlers, gymnasts, and other athletes who compete in weight-certification sports). For the vast majority of athletes, there is no strong evidence calling for protein supplementation.

5. Is it better to consume special mixtures of amino acids to increase muscle growth, or can proteins in ordinary meals do the job just as well?

Gibala: This question has not been directly examined using the most sensitive analytical methods, but I believe that the proteins in ordinary meals are probably just as effective as amino acid supplements for increasing muscle growth. In a series of studies from one laboratory, it was recently shown that skeletal muscle protein net balance following resistance exercise was increased to a similar extent whether subjects consumed mixed amino acids, essential amino acids, or a combination of amino acids and carbohydrate. It appears that the timing of protein ingestion after exercise, rather than the specific mixture of amino acids or the type of protein ingested, may be the more important factor influencing muscle growth. In addition, frequent feeding of small meals may be preferable to a single large meal in order to help maintain blood amino acid concentrations over a longer period of time.

Tipton: I agree; there is no evidence that consuming special mixtures of amino acids or certain kinds of proteins offers any advantage as far as increasing muscle growth. For most healthy exercisers, including athletes, it is likely that proteins in normal meals will be sufficient to stimulate muscle growth, provided, of course, that the training stimulus is sufficient. There may be a place for special supplements for certain populations, e.g., burn patients, the elderly, and bed-ridden individuals, for whom muscle loss is a problem.

Hargreaves: The amino acids contained in ordinary foods are sufficient; there is no need for supplementation with mixtures of specific amino acids.

6. How important is it to eat plenty of carbohydrates, in addition to proteins, if one wishes to maximize muscular development?

Gibala: First, to maximize muscular gains, an athlete should be taking in more food energy than is being expended, and carbohydrate should be the major energy source, i.e., at least 50% of total caloric intake. It is notable that although resistance exercise per se improves skeletal muscle net protein balance, protein breakdown exceeds synthesis if athletes train while fasted. Second, the rate of glycogen breakdown is very high during resistance exercise, and multiple sets of a single exercise can decrease muscle glycogen content by 20-40%. Therefore, carbohydrate ingestion is especially important following exercise in order to restore muscle glycogen concentrations. Failure to do so may compromise performance during repeated bouts of resistance exercise, especially during periods of heavy volume training for a particular muscle group.

Hargreaves: After eating carbohydrate foods, the carbohydrates are broken down mostly to glucose in the small intestine. As glucose is absorbed into the bloodstream, insulin is released into the blood. Insulin, in the presence of the increased amino acids that accompany the digestion of proteins, stimulates the synthesis of proteins in the muscles. Therefore, my opinion is that it is a good idea to eat meals rich in both carbohydrate and protein to optimize muscle growth.

Tipton: Dr. Hargreaves is probably correct in his assessment, but I prefer a somewhat more cautious approach. We know that for several hours, increased levels of insulin that are associated with carbohydrate digestion decrease protein breakdown and thus tend to increase the amount of protein in the

muscles. Additionally, we know that the combination of amino acids and carbohydrates consumed as supplements after exercise will, at least for several hours, cause greater protein synthesis in the muscles. However, it is not clear what influence these acute, transient improvements after ingesting supplements will have on muscle development on a long-term basis, and we don't know if the same effects would occur in response to carbohydrate and protein in ordinary foods consumed at meals on a daily basis. Thus, we do not know for certain how varying amounts of dietary carbohydrate will impact muscle growth in the long run.

7. Can supplements of branched-chain amino acids (BCAA) taken before and during exercise delay the onset of fatigue?

Hargreaves: If BCAA ingestion reduced the uptake of the amino acid tryptophan from the blood into the brain so that less tryptophan were converted to serotonin in the brain and if a buildup of serotonin in the brain caused early fatigue during exercise, a case could be made for consuming BCAA before and during exercise. Although there is sound evidence for most, if not all, parts of this scenario, the best studies directly testing the effect of consuming BCAA on performance show that BCAA ingestion does not benefit performance. In fact, a potential side effect of BCAA ingestion is an increase in plasma and muscle accumulation of ammonia, which itself can contribute to fatigue. On balance, it appears that ingestion of BCAA is not effective in improving exercise performance.

Gibala: The short answer is, No. Despite claims to the contrary, BCAA do not seem to be important fuel sources during exercise, regardless of intensity, and there is no solid rationale for BCAA supplementation. It is notable that even during very prolonged exercise, the concentrations of BCAA in skeletal muscle do not change significantly, suggesting that there is no shortage of these substrates for energy production. Moreover, carbohydrate loading or carbohydrate ingestion during exercise, as typically practiced by endurance athletes, reduces the contribution of BCAA to probably less than 1% of total energy expenditure. The most well-controlled scientific studies conducted to date have reported no effect of BCAA supplementation on exercise performance in humans.

Tipton: I think the responses of Dr. Hargreaves and Dr. Gibala are right on target. Some studies published a few years back suggested that BCAA supplements could delay fatigue during long-duration endurance exercise. However, these studies were not well controlled, and several reports since then have not shown any effect of BCAA supplements on delaying fatigue under normal circumstances. There is some evidence that these supplements may work in extreme conditions such as high altitude, but, at best, I would say the jury is still out.

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diets. Instrument validity and reliability are essential measurement traits for research, yet Kristal et al. (100) argues for one additional attribute; responsiveness. Using data from the *Women's Health Trial* (87) and the *Eating Patterns Study* (25), Kristal and his group reported that short FFQs can be as useful and responsive as multiple day food records. However, there are certain factors researchers need to be aware of that could affect responsiveness: 1) how well the instrument detects change both pre- and post intervention, 2) the relative susceptibility to bias with self-reported behavior, and 3) the type of intervention evaluated in terms of the magnitude of change (103).

Building on Kristal's earlier research, another study (168) was conducted to evaluate a survey instrument which measured dietary fat and fiber behavior patterns instead of intake. Denoted as a Fat and Fiber Behavior Questionnaire (FFB), a 33-item questionnaire was reported as reliable and valid for detecting modest dietary change in low intensity, self-help interventions. The survey was limited by its generalizability (tested predominately on older white females with higher education levels) and weakness in sensitivity for assessing changes in fiber patterns. Other later revised FFQ instruments (33, 103) have been used repeatedly in intervention trials and epidemiological studies involving men and women of varying backgrounds and ethnicities. Two large scale studies involving worksite health promotion, the *Working Well Trial* (17) and *Next Step Trial* (176), have used the widely accepted Hutchinson Cancer Center FFQ (103) and the Block/National Cancer Institute FFQ (33). For this study, Block's FFQ was selected due to its extensive use in studies involving fruit and vegetable intake (as well as fat) with regard to health and prevention of disease (31). A self-administered instrument, it has been tested and validated (30, 82, 129) for use in men and women of various ages and

backgrounds and recently had its nutrient data base updated to reflect more commercially recognizable foods. Additionally, this particular questionnaire provided a user-friendly dietary feedback report that was made available to the treatment group as part of the study protocol. An example of the study FFQ is in Appendix I.

Assessment of physical activity patterns in free-living individuals is a challenging undertaking considering there is no single best criterion to use. There are, as found with dietary assessment, many issues related to securing an accurate estimate. Additionally, there are complications due to the myriad of aspects to physical activity such as aerobic intensity, weight-bearing or resistive-style training, flexibility and strength concerns, and finally caloric expenditure. As such, a multiple measurement approach should be used to capture as many of these aspects. In essence, select an instrument that considers all dimensions of physical activity for both occupational and leisure time activity (27) yet limits reactiveness (alter behavior of subject when surveyed (99). The 7-day Physical Activity Recall (PAR) Questionnaire meets this criteria and has been used extensively within health-related and TTM studies to measure energy expenditure (27). It can be administered on an interview basis and captures data regarding a subject's usual physical activity habits for both occupational and leisure type activities. Blair et al. (27) found that with middle-aged men, the 7-Day PAR was sensitive enough to detect increase in physical activity. Sallis et al. (164) determined reliability (2 week test-retest) for the PAR using 53 men and women as part of the Five City Project conducted in 1979-80. Correlations for vigorous activities was r=0.83 and somewhat lower for moderate activity at r=0.75.

In TTM studies (44, 117, 146) conducted in the worksite, Blair's PAR questionnaire was used because of its demonstrated high validity and reliability scores (123, 126). Marcus et al. (117) used the PAR questionnaire in evaluating tailored versus non-tailored messages for exercise adoption at the workplace. Her sample included predominately white male, blue-collar workers with a majority of high school or college education. Peterson and Aldana (146) did similar research, using the PAR but had white collar workers with higher education levels and had even more male subjects. Burn and colleagues' (44) research took place in the UK and explored the association between readiness to change and coronary heart disease risk factors. The sample included office staff from a government agency in Britain holding clerical, managerial and executive positions. Because of the wide use of the questionnaire in TTM research involving promoting physical activity and its validity/reliability for men, the 7-day PAR instrument was selected for use in this study to measure energy expenditure. An example of the questionnaire is in Appendix J.

Physiological Data Collection. More objective data of a physiological nature were desired to more rigorously evaluate intervention effects beyond self-reporting measures. If self reported measures accurately reflect a change in behaviors, then these new behaviors should reflect changes in physiological parameters. To illustrate, self-reported increases in physical activity should reflect decreased BMIs (49) and higher VO_2 scores (49, 85). Blood lipids can provide an objective picture of reported reductions in dietary saturated fat and increased exercise levels (56, 68). Systolic and diastolic readings should also vary as regular aerobic exercise has been demonstrated to lower blood pressure in overweight individuals possibly as a result of weight loss which

decreases cardiac output and lessens peripheral vessel resistance (2, 5, 141). Current findings from the *Dietary Approaches to Stop Hypertension* (DASH) study has further reinforced the scientific understanding of nutritional influences on blood pressure. DASH researchers reported significant reductions in systolic and diastolic readings, for both hyper- and normotensive individuals, when consuming a steady diet low in total and saturated fat and rich in low fat dairy foods, nuts, fish, chicken, fruits and vegetables (163).

Therefore, physiological parameters such as blood pressure, body fat percentage, waist-to-hip ratio, BMI, blood cholesterol levels, VO_2, and resting heart rate were evaluated. The United States Air Force (USAF) currently uses circumferential measurement to assess body fat (8). According to the literature (130), circumferential measurement is appropriate for obtaining a general idea of body fat composition. The USAF uses the measurement because it has been demonstrated to be sensitive enough to detect body fat changes in individuals who have been placed on weight management programs (8). Waist-to-hip and BMI measurements correlate with blood pressure and plasma lipids and have been suggested as good anthropometric measurements as part of routine clinical examinations (92, 110). Jensen (94) validates the use of anthropometric assessments in population type surveys. They are rapid, inexpensive and can evaluate relative nutritional status. More expensive and time consuming techniques such as densitometry, dual energy x-ray absorptiometry, bioelectric impedance are more appropriate for measuring small changes in ill or injured individuals or evaluating athletic performance effects.

Invasive procedures such as blood draws for lipid panels are considered reliable indicators of coronary heart disease risk and fat in the diet (50, 74). Significant improvements in blood lipids have been shown when diet and exercise are used in concert to promote weight loss and recurring physical activity habits (4). For this particular study, blood lipids will be analyzed for reductions in total cholesterol, triglycerides and LDL cholesterol. As exercise levels increase throughout the study, a concomitant increase in HDL cholesterol should be observed (84, 184).

Oxygen uptake (136) has been used as a measure of one's cardiorespiratory fitness (136). Within the Air Force, sub-maximal cycle ergometry testing has been adopted as a means of estimating oxygen uptake for determining fitness (142). Aerobic fitness is a characteristic of positive health and functional capacity (83), an essential attribute of Air Force personnel in order to perform mission related duties in times of emergency or war (186). Along with age and gender, other important variables associated with the test include resting heart rate and weight. Efforts to lose weight and increase physical activity levels generally result in improved VO_2 scores. Trained muscle has greater ability to use fat as a metabolic fuel leading to further percent body fat reductions. Additionally, data have shown that percent body fat is inversely related to aerobic capacity (136) relative to body weight and athletic performance (54). Resting heart rate also correlates with fitness (66, 89) and as a risk factor for cardiovascular and noncardiovascular disease (81).

Staging Algorithms. According to Reed and colleagues (158), an algorithm "is a short measure that categorizes a subject into a single, discrete stage." Stage is a vital aspect of the TTM and accounts for the manner in which it is primarily operationalized.

Unfortunately, there are no gold standards for diet and exercise algorithms due to the complexity of these health behaviors. As such, there is less agreement in the literature as to which particular algorithm to use for studies involving diet and exercise. Substantial research has been done in validating a number of different algorithms, with considerable attention paid to the formatting and selection of discrete behaviors to measure. Initial exercise algorithms were based on instruments used in the very early studies involving tobacco cessation therapies (26).

The first physical activity algorithms to measure stages of exercise adoption were in the shape of a ladder, where subjects had an 11 point scale in which to describe their current exercise behavior (116, 123). Other refinements by Marcus et al. (113, 124, 125, 126, 127) of staging instruments adapted from Prochaska (147) led to a five choice staging measure using either a Likert scale or true/false response format. In a 1997 review paper (158), researchers investigated the results of four large studies (123, 126, 157, 160) that used various forms of exercise staging algorithms. Essentially, the group found several interesting findings, which pointed to a more effective exercise algorithm. For the most part, it was recommended that an exercise algorithm should have an accurate description of the behavior criterion (frequency, intensity and duration of exercise is clearly stated), have measurement benchmarks that are applicable to the target audience (list examples of what exceeds the criterion and which do not), and use a true/false with five choice response format for the algorithm instrument.

According to Reed et al. (158), this five choice format is the most valid and reliable based on the data presented in the review. Other validity studies have, for the most part, confirmed this finding (49, 85). A number of studies have gone on to use the

five choice format as a staging tool for a variety of research protocols (44, 107, 114, 117, 146). In addition to its reliability and validity for staging exercise behavior, the instrument also has significant association with the Seven Day Recall Physical Activity Questionnaire for self report measures (123, 126). The algorithm has been used with predominately white male populations with some college education and holding both blue- and white-collar job positions. The specific physical activity algorithm used in this study was adapted from research by Marcus and co-workers (125, 127) and an example can be found in Appendix A.

Dietary algorithms for stages of change are also complex due to the nature of the dietary continuum (consuming more fiber, fruits, and vegetables, reducing fat and saturated fat, increasing calcium intake, etc.) and the fact that dietary change is not an all or none event like smoking. Curry et al. (55) is credited with the first study to show stage association with low fat diets by developing a dietary staging algorithm for fat intake. Again, using material from Prochaska's (147) smoking cessation research, researchers devised a six-part staging survey, which placed subjects into a discrete stage for fat reduction in their diet.

Later research by Rossi et al. (162) evaluated four different styles of algorithms for fat reduction and reported all four discerned decreased dietary fat intake levels across the higher stages of change. Of note, however, is when the group changed the wording in algorithms from "being on a low fat diet" to "limiting the amount of fat in their diets," percentages of those considering themselves in action or maintenance increased. Glanz et al. (72) extended this study using dietary staging algorithms by evaluating instruments that measured both dietary fat and fiber as part of the *Working Well Trial* (17). Realizing

the need for researchers to consolidate individual assessment of the healthfulness of one's current diet and evaluate low fat and high fiber intake concomitantly, Glanz (72) developed an expanded dietary algorithm which was pre-tested and pilot surveyed. Significant associations between self reported (for fat, r=0.37 and for fiber, r=0.37) and objectively assessed measurements (for fat, r=0.49, and for fiber, r=0.28) were reported for the expanded algorithm. Others (175) have used this same dietary algorithm and found it valid for fat, fiber and fruit/vegetable intake stage in male autoworkers. As was determined from the earlier research (162), investigators saw during the development and implementation of experimental algorithms, wording must be very clear and definitive when describing behavioral criteria for desired change.

Further enhancements of dietary algorithm instruments revealed other shortcomings in staging classifications due to inaccurate individual perceived intakes of nutrients. Greene et al. (79) found much lower numbers of subjects in action and maintenance for fat reduction when incorporating additional behavioral criteria to a staging algorithm. Auld et al. (19) corroborated these results in 1998 using a staging instrument that included attitudes (Do certain foods put you at risk for certain diseases?), beliefs (What are current dietary guidelines for meals in terms of fat content?), and more objective measures of dietary behavior (How often do you use butter on rolls?). The group found their method classified a higher percentage of subjects in the preparation stage and lower percentage in the more advanced stages than previously identified in other studies.

Greene and Rossi (76) have indicated in their research with TTM and reducing dietary fat that previous algorithms had failed to use the correct behavioral criteria in

assessing change, especially for the latter stages. They refined an earlier dietary fat algorithm to include a three-step process that more accurately assessed an individual's stage for fat reduction behavior. This important element of their algorithm provided more specific behavior criteria by which individuals could compare their behavior with true indicators of low fat practices (i.e., do you use low fat dressing on your salads?). Using behavior as a criterion has been found to be more sensitive in detecting dietary change than use of nutrient intake (i.e., is fat intake $\leq$ 30 percent of total energy?) (77, 103).

Kristal et al. (101) recommend discretion when using nutrient intake as a criterion for staging because of errors that could be made in the data analysis. One good example is using the criterion of limiting fat intake to 30 percent or less of caloric intake. In most situations, people do not relate to this recommendation and often do not correctly assess their actual fat intake. Further, Kristal and colleagues argue, because of the complexity of dietary behaviors, it is sometimes difficult to determine behavior change success. For example, if an individual increases his/her fruit and vegetable consumption to just under present recommendations and maintains these changes for a longer than a year, are they considered in maintenance or preparation? The question then becomes is it more important that change occurred toward a more positive behavior or whether the individual truly met the recommendation at all? The other concern raised by Greene et al. (80) is inaccurately staging individuals, especially those who think they are meeting recommended guidelines and are not. Ironically, these are the individuals who may better respond to the tailored treatment because of their intent to change.

As found with exercise, the key to the successful use of any algorithm is ensuring an objective criterion is established. Due to some of the difficulties associated with accurately determining one's dietary fat intake (type of fat, measures of fat intake, validation of fat intentions/behaviors, etc.), daily servings of fruit and vegetables were selected as the dietary behavior to assess. Servings of fruits and vegetables are somewhat more easily appraised objectively by individuals, and there is limited public awareness of the National Cancer Institute's *5-a-day for Better Health* campaign (47). Further, it also may be of benefit to concentrate on increasing nutrient dense foods (fruits and vegetables) which do not have the negative connotations that comes with restricting certain foods in the diet (70, 166). As indicated in earlier research (134, 137), fat and fiber intakes are inversely correlated. With increased fruit and vegetable intake, one may observe a concomitant decrease in fat consumption.

Lechner et al. (109) developed a more stringent fruit and vegetable classification in their dietary algorithm. Although used in Dutch populations, they found using a more objective measure such as whether a person is actually meeting current nutritional guidelines, far more effective in distinguishing those in earlier stages from latter stages. As formerly reported in other research, Lechner found by not using more objective criteria, the primary problem is people judge themselves to be in a advanced stage, but in reality are in a lower stage. This appears to be more so with action or maintenance stages.

Campbell et al. (47) also developed a dietary algorithm for fruit and vegetable intake. Although measuring individual intention to eat more than 5-a-day, their study pointed out the importance of using behavioral criteria (whether eating the recommended

servings or not) to define stages more accurately. They reported lower proportions of subjects in the more advanced stages for fruit and vegetable intake behaviors than was found with TTM studies for reduction of dietary fat intake. Authors contend much higher numbers may have been reported if different criteria were used such as "trying to eat more fruits and vegetables to reach 5-a-day levels." Brug et al. (36) found this to be the case in his research where action was described for those trying to eat more fruits and vegetables. However, as before with other ambiguous criteria, some misclassification did occur at higher stages with subjects actually consuming less than recommended levels. Interestingly, LaForge et al. (106) tried differentiating between stages by decreasing the amount of servings needed to move on to the next stage (consuming 3-4 servings per day to move into the preparation from contemplation stage). It may be possible that incrementally raising serving levels between stages may be more facilitative in eliciting behavior change rather than an all-or-none situation.

Consequently, in this study, an algorithm to measure dietary change was adapted from previous fruit/vegetable TTM studies (47, 106, 109) which appeared to more accurately place subjects into the correct stages for their fruit and vegetable intake. Although the original algorithms (47, 106, 109) were used in mixed ethnicities and genders, its successful use suggests possible applicability to the study sample of enlisted military personnel. In most cases, subjects averaged between 30-50 years of age and possessed high school or college level education. In Appendix A is an example of the dietary algorithm that was used in the study.

Research Summary

Apparently, in spite of concerted efforts to encourage Americans to engage in healthy lifestyle habits, the message is not getting through. Past and ongoing research provides disconcerting data that indicate consequences of poor diet and physical activity behaviors (3, 6, 53, 63, 106, 167, 173). Obesity rates climbed from 12 percent in 1991 to 17.9 percent in 1998 across all age groups, genders, ethnicities and educational levels (135). The medical impact will be grave as the health care system could be overwhelmed trying to treat the multitude of chronic disorders associated with obesity, such as cardiovascular disease and diabetes.

Although consumer health information is widely available, it is not enough to convince individuals to modify existing deleterious behaviors (182). There are many programs on hand to aid those already motivated to improve poor habits, yet there is little consideration for persons less inclined to change. At the urging of the health professions community, more research is being done using behavioral-based theories to promote wellness in all types at risk. The TTM is one example of a behaviorally-based theory that uses a variety of techniques to facilitate change. It is appropriate for anyone, yet highly individualized to allow for the varying levels for readiness to change within people. Based on recent successful research, both Glanz (69) and Marcus (118) advocate educational and behavioral interventions that incorporate the TTM. Accounting for differences in mental preparedness to change by using tailored information has revealed improvements in both dietary and physical activity patterns. However, additional study is warranted in other populations (115), genders (115), dissemination of TTM materials (120), and validation of outcomes (69, 118).

Hence, this study provides new data heretofore unreported. The utility of the TTM in improving fitness levels in male U.S. Air Force enlisted personnel was evaluated, a population previously not investigated. In addition, two health behaviors, diet and exercise, were simultaneously targeted for change instead of just one. Further, TTM materials were delivered to the target audience via the Internet as an interactive venue in place of other conventional means. Lastly, to complement the use of self-report measures as part of the intervention evaluation process (as seen in other TTM research), additional physiological parameters were also collected to increase design rigor through objective assessment.

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CHAPTER 3

DESIGN AND DEVELOPMENT OF A WEB-BASED NUTRITION EDUCATION PROGRAM FOR ENLISTED AIR FORCE MEN

Introduction

Investigating and developing focused health promotion interventions are a requisite for effective results. Nutrition education efforts are at the vanguard of this challenging process to promote behavior change in those leading unhealthy lifestyles. The newly released national health recommendations, *Healthy People 2010* (1) and the *2000 Dietary Guidelines for Americans* (2) are adamant in establishing objectives towards improving both diet and physical activity habits of U.S. citizens. Detailing statistics from past and current surveys, both documents cite concern for an escalating epidemic of disorders such as obesity, diabetes, and coronary heart disease from current negative health behaviors. Although the amount of fat in the U.S. diet is purported to be decreasing, only 32 to 34 percent of adults met *Healthy People 2000* guidelines (30). Additional data show total calories consumed are rising (3, 31), and fruit and vegetable intake is less than recommended (25, 51, 53). Physical activity levels are also far from acceptable for maintaining good health. Approximately 60 percent of the adult population is inadequately active while another 25 percent has been reported to be completely sedentary (4, 5). Though these data reflect the general American public, there

is evidence that the U.S. military may also have some health behavior issues with which to contend.

The United States military establishment continues to ensure a fit and ready force by incorporating fitness and weight standards for its personnel. With the advent of a Department of Defense health promotion directive (6) No. 1010.10, implemented in 1986, every branch of the service has undertaken the essential measures to improve and maintain military readiness of all its personnel. This document provided a health promotion template for all the services to follow in terms of ensuring strict adherence to weight and fitness standards. Specifically, six major interest areas were identified by the directive for health promotion emphasis: a) smoking prevention and cessation, b) physical fitness, c) nutrition, d) stress management, e) alcohol and drug abuse prevention, and f) early identification of hypertension (6). Interestingly, each of the aforementioned interest areas could be considered modifiable risk factors. U.S. data show the current major causes of death are due to chronic diseases such as cancer, coronary heart disease, diabetes and stroke (1). Personal lifestyle choices such as smoking, high fat and cholesterol intake, alcohol use and inactivity are associated with these disorders (1, 2).

These same negative behaviors exhibited in military personnel at excessive rates could result in an unprecedented drain on medical resources, degradation of job performance and, adversely impact mission accomplishment. Recent United States Air Force (USAF) and Department of Defense (DoD) studies have shown that military personnel practice unhealthy behaviors which has cost several million dollars in direct health care costs and lost productivity (7, 8). In 1995, an Air Force Behavioral Risk

Factor Surveillance Pilot Study (9) found only 76 percent of the active duty personnel reported their health as good or excellent and 14 percent provided height and weight measurements that yielded a BMI exceeding CDC recommended criteria for health. A 1998 DoD survey showed that USAF members have the lowest total involvement in strenuous physical activity of any of the services (10).

Although Air Force nutrition and exercise programs exist to aid personal efforts towards greater physical fitness levels and improved dietary habits, these programs do not consider the cognitive state of preparedness to change in the individual. In other words, most exercise and nutrition programs are designed for those who have made the commitment to be physically active and eat nutritionally balanced meals. Maintaining proper nutritional and exercise habits remain elusive for some, especially for those who have difficulty reaching prescribed military standards. Marcus showed that scores on a physical activity behavior survey conducted at a worksite significantly differentiated employees among various behavioral stages of preparedness (40). The most effective approach according to the literature (40, 41, 47, 48, 52) is to implement a strategy that uses stage-matched materials based on Prochaska's Transtheoretical Model of Behavior Change (TTM) (47, 49). In other words, devise programs that correctly identify the particular needs of the individual for the current health behavior exhibited and then match the appropriate intervention for the treatment.

Consequently, the USAF has encouraged newer research initiatives as part of the *2000 Air Force Healthy Communities Research Program* (11). Using the (*Healthy People 2010*) objectives and the previously mentioned DoD directive as a foundation, this program calls for more research pertaining to innovative health promotion and

disease prevention methods. Specifically, within the topic areas of "physical activity and fitness" and "nutrition," the Air Force has requested further investigation regarding the: 1) adoption of healthy behavior patterns, including social skills, attitudes and knowledge of adopting regular activity programs, 2) developing effective educational methods to translate dietary recommendations into appropriate food choices and sustained behavioral changes, 3) exploring reasons people change or do not change behavior related to health as a result of exposure to health promotion programs, and 4) study and development of work-site programs and their impact of likelihood to make needed lifestyle changes. Because of the USAF's reputation as a technologically driven service, it is plausible that the use of computers to promote nutrition education efforts would be of value in terms of reach and effectiveness. Further, due to the paucity of research associated with using the TTM in military populations, additional study would add to the growing body of evidence involving this particular behavior change model. Combining aspects of computer technology in concert with the TTM in achieving USAF health promotion objectives are clearly justified.

A twofold study, this paper reports preliminary findings regarding the initial development of an experimental nutrition education program using Internet technology based on the TTM. The development phase entailed using focus group data and recommendations from the literature to design a web site intervention program, *Let's Get Moving!* The second portion of the research evaluated the effectiveness of the developed intervention using a randomized controlled design and is reported elsewhere (56). The ultimate objective of the intervention was to improve fitness levels in Air Force personnel through behavior change. While this study is specific for a particular audience, it serves

as a model for a theory driven, technologically based nutrition education program for use in worksite health promotion programs.

Methods

Recruitment of Subjects. The focus group method was used to obtain qualitative information to design the experimental intervention. Subject participant pool was open to all Air Force enlisted male active duty personnel, aged 30-44, assigned to Peterson Air Force Base. This segment had difficulty in passing the Air Force cycle ergometry fitness test and, for this reason, was considered the targeted group for the planned intervention (12). A nearby air force base was selected due to its physical proximity and similarity to other Air Force installations (a wide variety of career fields and specialties). Recruitment of test subjects through the base Health and Wellness Center was accomplished using flyers/posters, base newspaper advertisements and personal contact. Some individuals were obtained through "snow-balling" where previous participants informed eligible co-workers about the study. Although the aim of the study was to help those in need of improving their fitness levels, a variety of focus group participants, from elite athletes (to obtain data on successful diet and exercise habits) to the sedentary (to determine what precludes proper dietary and exercise habits) were desired. A wide selection of opinions and ideas regarding success and failure in sustaining good nutrition and health habits were obtained and subsequently utilized in the development of the intervention. Approval was obtained from the United States Air Force Academy Institutional Review Board and the Colorado State University Human Research Committee (Appendix B).

Formative Evaluation. Six focus groups were conducted over a three-month period to obtain qualitative information in developing the intervention. Protocols were based on previous guidelines (38, 55). All potential focus group participants were screened, provided a consent form and enrolled by the research investigator. If participants met the criteria, each individual was given a date and time for attending. All sessions were held in a central location on the base. Just prior to each session, each participant was contacted to confirm attendance. Preceding the beginning of the discussions, all participants read and signed informed consent forms (Appendix B) and completed a demographic survey (Appendix C). A moderator led the discussions using questions derived for the focus groups (Appendix D). Questions were developed around four main objectives: 1) determine what negative and positive motivators these individuals face regarding proper nutrition and exercise, 2) determine what triggers relapses in healthy eating and exercise habits, 3) determine what individuals require in terms of nutritional and exercise information to sustain healthy eating and exercise habits, and 4) determine how this information should be disseminated (classes, newsletters, self-paced materials). The moderator faced the participants in order to direct questioning. The assistant moderator (research investigator) sat at the back of the room, took notes and clarified questions for the participants. Discussions were tape recorded for analysis purposes and subsequent development of the intervention. To avoid any undue influence or dominance based on rank or identification through uniform nametags, participants attended the sessions in civilian clothes and were only addressed by their first name. After the sessions ended, the moderator and the research investigator compared notes that summarized the group discussion.

Demographic Data. Six focus groups entirely consisted of enlisted males ranging in age from 30 to 42. Total group participation was thirty members and individual group size varied from three to seven. Demographically, all had at least a high school education and 67 percent had attended college without a earning degree. Nearly a quarter possessed a baccalaureate degree, and a small percentage (7 percent) held a graduate degree. A little over half of the participants were involved in some structured fitness program such as weight lifting, cycling, competitive running or tae bo. The majority (79 percent) worked out at least 3 times per week and not one participant reported being on the weight management program (although over 40 percent reported dieting at one time or another, struggling with proper eating habits). Close to 70 percent of the group claimed to always pass the cycle ergometry fitness test ("bike test"), with 10 percent usually passing the test and 20 percent failing the test more than once. This failure rate compares with the 21 percent of focus group participants who acknowledged working out just prior to taking the bike test instead of working out year round in preparation for the fitness test (focus group data, Table 3.1).

With regards to meal pattern consumption, 40 percent of the focus group participants consumed their breakfast meal at home with over 30 percent skipping the meal entirely. This figure coincides with research that found that 29.2 percent of Air Force personnel rarely or never consume a breakfast meal (57). Location of lunch meals varied widely among various commercial eating establishments, both on and off base, and home. Dinner was almost exclusively at home with some occasional eating out. A summary of the demographic data is listed in Table 3.1.

TABLE 3.1. Demographic Information from Focus Groups

Variable	*Number (%)*
Male	30 (100.0)
Ethnic group	
Caucasian	26 (86.7)
African-American	3 (10.0)
No response	1 (3.3)
Age group (yr)	
30-34	5 (16.7)
35-39	18 (60.0)
40-44	4 (13.3)
No response	3 (10.0)
Education	
High school diploma	1 (3.3)
Some college credit	20 (66.7)
Bachelor's degree	7 (23.3)
Advanced degree	2 (6.7)
Fitness test results	
Always pass	20 (66.7)
Usually pass	3 (10.0)
Failed more than once	6 (20.0)
No response	1 (3.3)
Work out just prior to fitness test	
Yes	7 (21.0)
No	23 (79.0)
On Air Force weight management program	
Yes	0 (0)
No	30 (100.0)
Ever on a diet	
Yes	12 (40.0)
No	17 (56.7)
No response	1 (3.3)

n=30

Results

Focus Group Discussion Findings. Discussions uncovered several perceptive ideas with which to design an intervention. Although biased to some extent by the self-selection recruitment of health conscious participants, review of the earlier demographic data and participant comments revealed a broad range of health interests. Because of the variety of the type of questions (round-robin, open, group activity) every participant was given the opportunity to speak and did so in a very candid professional manner. The generally high agreement within and between groups regarding their thoughts on nutrition and physical activity habits enhanced data validity. Results indicated that an interactive intervention would be well received, however, it needed to contain certain key elements. Participants desired an interactive intervention which provided both exercise and nutrition information as one message, offered relevant information specific to individual needs and engages the Internet as a means of dissemination.

Further, focus group participants requested certain subject content areas for clarification and additional information on exercise and nutrition. These included:

1. Provide easy to comprehend information on how cycle ergometry works to assess fitness
2. Help in deciphering and reading food labels
3. How to manage fat in the diet and explain differences in types of fat
4. How the body repairs itself after injury and workouts
5. Metabolism of the body during exercise
6. Nutritional supplement use and safety
7. Sorting out misinformation/research studies on nutrition
8. Preventing relapse in diet and exercise
9. How to set appropriate and realistic goals
10. How to prepare healthy foods quickly and inexpensively

Pilot Testing of Materials. As a means of evaluating program relevancy and application for the intended audience, a small test group of 16 individuals initiated the study ahead of the main intervention group. This allowed time for any necessary revisions to the experimental program prior to implementation with the main group. Preliminary research revealed some minor problems reading text when subjects used different browsers to view the messages from the Internet. The web design firm, DataWest, Inc., corrected this with some computer code revisions written for the site. Some subjects expressed a need for conveniently reaching a health professions expert. A link was added to the welcome page that provided the research investigator's e-mail address in order to answer questions or resolve technical problems subjects may have encountered while using the site. Lastly, several test group subjects asked if links to the various parts of the web page could be placed at the top and bottom of the page so web site users did not have to scroll up and down repeatedly to access the next section. This request was also accommodated along with the other changes made by the web design firm.

Use of Information Technology in Health Promotion. Computers have been used extensively as an adjunct tool in the health profession field for a number of years. In recent times, the utility of using computers to both disseminate health information and educate individuals has become apparent. Both Dirkin (28) and Dunn (29) promote delivering lifestyle interventions through media-based, interactive computer programs. Although not accessible to all populations, health care providers can reach greater numbers at a much more cost effective basis, and improve client access to authoritative

health professionals. In a review (42) of physical activity studies using mass media technology, intervention programs with follow-up contact and tailored information for the target audience, were more successful in the long term. Marcus et al. (42) suggested further research using media based technology such as interactive web sites to deliver tailored information in controlled studies. Thus far, results have been somewhat limited for computer tailoring in physical activity studies (21, 22, 36). A review of the literature (16) for studies involving computer-tailoring in nutrition education provides more promising data. Brug's research (17, 18, 19), while primarily in Dutch populations, has been effective in affecting behavior change for fruit, vegetable and fat intakes. Others (23, 36, 58) found similar results in U.S. populations. In short, many who have used computer tailoring argue for its effectiveness based on participant comments that the health-related information was more likely to be read, retained and used because of their personal and relevant content.

Development of the Web Site Program. Analysis of data obtained from six focus groups revealed the majority of participants desired a web-based health promotion program that provided relevant, concise and easy to understand information. Further, the program should be flexible and convenient to access at any time. Because of a number of recent regional crises in the world, USAF forces more frequently have been required to deploy away from their home installations than in the past. Subsequently, the web site was designed as a flexible intervention, accessible from anywhere in the world, provided there was Internet availability. Nearly all locations where USAF personnel are deployed have Internet capable computers available as part of their duties or for morale purposes.

Other discussion indicated frustration with generic-type information not suited for individual need as well as conflicting health information. Participants were more inclined to use nutrition education materials if the materials were straightforward and provided a variety of recommendations to improve one's health habits, versus receiving the usual care guidelines. Participants in all focus groups agreed that both nutrition and physical activity knowledge should be presented together as an integrated topic.

On the basis of focus group discussions, review of the literature concerning the TTM and use of computers in health promotion, an interactive web site program was created. As determined from earlier research (17), three important components are required for successful implementation: 1) selection of suitable staging algorithms in which to categorize subjects to receive appropriately matched information, 2) careful development of the nutrition and physical activity newsletters which are tailored to every possible stage, 3) incorporate an advanced computer program which can effectively and expediently match an appropriate newsletter to a staged reader.

Newsletter Content Development. The overall objective of the study was to improve fitness levels in the intervention group with stage-matched health newsletters to initiate or sustain positive behavior change. Data from the focus group research revealed participants desired more information on both nutrition and exercise to improve fitness. In light of the critical importance for theory-driven research, these data were incorporated within a web-based nutrition education program based on the TTM. According to the literature (49), a minimum of six months is required for those in contemplation to progress. Current traditional USAF programs allow those who fail an initial fitness test,

an additional six month period of preparation to pass a second. Accordingly, the length of the study was established at six months.

In order to ensure coverage of each possible stage in a six-month period, a total of sixty individual and differently tailored messages were written for both nutrition and exercise. Because overwhelming evidence (15) has shown high fruit and vegetable intake and an active lifestyle promotes longevity, both factors were used as a central health message theme and were incorporated within the additional nutrition and exercise information topics desired by the focus group participants. The entire program was then based on the TTM to elicit behavior change within the target group.

A number of researchers have used the TTM in a variety of health promotion settings (17, 18, 21, 23, 26, 43, 44, 54). According to proponents who have used the TTM, the most effective way to change behavior is to use as many of the four TTM constructs as possible. For the current investigation, each of the key constructs (stages of change, processes of change, decisional balance and self-efficacy) were built into the newsletters by using four main content heading areas. Denoted as "*Points to Ponder,*" "*Check Your Learning,*" "*Did You Know?*" and "*Want to Know More?*", these content headings integrated the principles associated within each of the constructs. Because the intent of the study to improve fitness by changing certain nutrition and physical activity behaviors according to an individual's stage, specific constructs were used at certain times within the newsletter content. While the content headings ("*Points to Ponder,*" etc.) remained the same throughout each of the newsletters for consistency and ease of reading, the construct use varied to match the appropriate strategy with the individual's stage (as determined by the stage algorithm). Each content area was written in order to

elicit a specific behavioral outcome which was linked to the overall study objective to improve fitness. For example, in a contemplative stage newsletter, the content is written using the processes of change specific to obtaining a decision and a commitment to change to a new behavior within the next 30 days. With the newsletter content created in this manner, the desired outcome is to move the subject (hereafter referred to as the reader) to the next stage (preparation) where they now pledge to initiate the new behavior in the near future. Ultimately, the goal is to have the reader commit to performing the stated behavioral outcomes in the second part of the study:

- Reduction in calories from the diet
- Decrease in percentage of energy from fat and saturated fat
- Increase in fiber intake
- Increase in fruit and vegetable intake
- Increase of recurring physical activity

A more in-depth explanation of this method is provided in the section under newsletter application. A description of how each of the content headings are used is listed below:

"Points to Ponder" – In this section of the newsletter, the reader is introduced, each month, to one of the topic areas requested by the focus groups. The overarching theme, however, in each newsletter, is increasing one's daily intake of fruits and vegetables and level of physical activity. The intent of this section is to first acquaint the reader with the particular information. The next step is, depending on the stage, to either use that information to "motivate" the reader to think about changing their behavior, or provide "how-to" information to help readers enhance their current positive behaviors.

"Check Your Learning" – This tool is used as a learning activity to help readers review and then apply the information they have just read. For readers in an earlier stage, this section potentially increases their level of awareness, compares problem behaviors with positive ones and helps build confidence in practicing the new behavior. For those in a later stage, it worked to help reinforce and reward the current behaviors by allowing readers a chance to demonstrate what they already know and routinely practice. Additionally, a short motivational phrase for exercise was placed at the bottom of all newsletters for diet and similarly, a short phrase for diet for all exercise newsletters. This "cross-marketing" technique was done to foster healthy habits across both behaviors simultaneously.

"Did you Know?" – This section was an instrumental part of the newsletter which offered additional thought-provoking information related to the topic areas in the *Points to Ponder* main message. This particular part of the newsletter addressed focus group desires to have concise, applicable information as well as the need to "include new information and repeat it for learning purposes" (45). Once again, information was "stage appropriate."

"Want to Know More?" – This area was a last opportunity to aid the reader in obtaining authoritative and reputable information from ancillary diet and exercise web sites. The reference sites were selected based on their accuracy and scientific merit as well as readability for the lay public. For those in precontemplative and contemplative stages, these sites can provide more motivational information (as opposed to commercial sites with advertising and extravagant health claims) and increase awareness for problem behaviors. Higher stage readers can use the sites to look for additional information to

reinforce their knowledge of established behaviors in addition to looking for new ways to practice them.

Newsletter Application. As mentioned earlier, each newsletter had a particular health message for a staged reader. Using specific constructs of the TTM, each reader is strategically guided to either change their problem behavior or sustain an established positive behavior. To ensure consistency and accuracy in obtaining the desired effect, a newsletter matrix (Table 3.2) was used which outlined the requisite elements for change for that particular stage. Matrices for all stages are provided in Appendix E.

Precontemplation. The main processes utilized in this stage are consciousness raising, dramatic relief, self re-evaluation and environmental evaluation. Prochaska (47) cites these processes as the most critical for individuals in both precontemplative and contemplative stages. In the precontemplative newsletter, these processes are accomplished by pointing out the health risks of the problem behavior using national health statistics and personalizing the information with thought-provoking questions aimed at the reader. To increase reader awareness, results from scientific studies which apply to their problem behaviors are detailed and misconceptions about that behavior are corrected.

Contemplation. Although the processes which were emphasized in the precontemplative newsletter are also contained within this stage, Prochaska (47, 49) advises that effort should also begin on building self-efficacy and decisional balance constructs of the model. The contemplative newsletter introduces the benefits of a new beneficial behavior while playing down or resolving the negative aspects of the current behavior. Attempts are to initially increase confidence and motivation by making the.

TABLE 3.2 Newsletter Matrix Example.

STAGE	CONTENT AREA	CONSTRUCTS	STRATEGY/CONTENT ELEMENTS	OUTCOME/OBJECTIVE
Precontemplation	"Points to Ponder"	Consciousness-Raising Dramatic Relief Environmental Re-evaluation Self Re-evaluation	Increase awareness of problem behavior using factual information: ✓ Mention risk factors of and consequences of unhealthy lifestyle ✓ Financial impact and burden of disease treatment ✓ National health statistics Use "personalized" thoughtfully constructed questions to get subjects to evaluate their behavior. Allow subjects to consider the need to make change: ✓ Pose as risk to themselves by engaging in unhealthy lifestyle ✓ Pose as other outside risks such as quality of life w/family or jeopardizing career w/Air Force	Think about the possibility in the next six months or sooner: ✓ Increasing fruit and vegetable daily servings ✓ Increasing daily fiber intake ✓ Decreasing daily total and saturated fat intake ✓ Increasing physical activity levels ✓ Reduce calories
	"Check Your Learning"	Consciousness-Raising	Learning activity to aid subjects in initially grasping factual information ✓ Key in on health statistics ✓ Key in on introducing behavior change methods to reduce risks	
	"Did You Know…"	Consciousness-Raising	Used to help subjects see the significance of behavior change from a larger perspective ✓ Additional health statistics ✓ Results from scientific studies ✓ Resolving myths about diet and exercise	
	"Want to Know More"	Consciousness-Raising Dramatic Relief	An additional opportunity to further enhance subject's understanding of the problem behavior using outside credible and authoritative sources ✓ Professional organizations (AMA, ADA, ACSM, etc…) ✓ Government organizations (NIH, USDA, DHHS, NAS, CDC, etc…) ✓ Trade organizations (Produce for Better Health, National Dairy Council, Wheat Foods Council, etc.) ✓ Others (American Cancer Society, American Heart Assoc, etc.)	

reader aware they may already be making changes, emphasizing small changes at first and the importance of setting practical goals

Preparation. Because the reader at this stage has accepted the need for change and has committed to actually making a change in the near term, further emphasis is placed on building confidence and accentuating the benefits of the new behavior to initiate change. Several reports (34, 37, 41) have emphasized getting those in preparation support from family and friends in trying out this new behavior. These researchers also indicate the importance of commending the individual for committing to a change through self-liberation. Preparation newsletters provide positive feedback at the beginning of the message as well as stressing that the reader is empowered to make the right choices concerning that behavior.

Action. In this stage the reader has initially engaged in the new behavior but is potentially vulnerable to lapsing into old behaviors. It is here that Prochaska (47, 48) calls attention to the three additional processes of counter-conditioning, stimulus control and contingency management. These particular strategies are very important in helping a recent changer focus on the new behavior and avoid relapsing. Action newsletters carryout these processes by giving readers examples from successful changers where they removed cues for unhealthy behaviors, substituted prompts for healthier alternatives and subsequently rewarded themselves for taking steps to change in a healthier direction. These newsletters also remind the reader of the dangers of returning to an earlier stage and how to prevent it.

Maintenance. The hallmark of this stage is the ongoing practice of a new behavior and the effort to prevent relapse (47). However, because those in maintenance

are less tempted to relapse and are more confident of sustaining their changes, they do not apply change processes as often as those in an earlier stage. Nonetheless, the literature (47, 48) does stress the requirement to continue those processes used in the action stage in addition to social liberation and warning about the potential for relapse. Individuals need to practice their changed behaviors in society and the public eye as a way of further reinforcing the change. This is important for a number of reasons but primarily to gain acceptance in the eyes of others as well as rewarding themselves by announcing their own success with a healthier lifestyle. As with the previous stage, maintenance newsletters aid this strategy by providing examples from successful changers and encouraging the use of friends and family especially in the social environment. Maintenance newsletters also advise the reader that, while not desired, recycling to an earlier stage is a normal part of the change process. The important point raised, however, is to anticipate the potential to lapse and the need to plan ahead. Examples are provided to further educate the reader.

As mentioned previously, Table 3.2 provides an example of the matrix that was used to create and apply each staged newsletter to obtain and sustain change in the reader. While the targeted sample had at least a high school degree or more, the content and formatting of the newsletters were created based on guidelines for developing printed materials in nutrition (32, 45, 46). All newsletters were written at or below the 10^{th} grade reading level as determined by the Flesch-Kincaid system (32).

Web Site Layout and Design. The actual layout of the web site was modeled after previously used health newsletters for diet and physical activity. The web designer firm, DataWest, Inc., professionally arranged all the graphics, links and text on each page to

ensure a user-friendly site. To prevent unauthorized use, each subject from the intervention group received a specific URL address, logon and password to access the site. Upon logging onto the web site, each subject viewed a welcome screen, where they were required to first take a survey (staging algorithm) to stage themselves for a particular category in their nutrition and physical activity habits. The algorithms were adapted from previous research that staged for diet and physical activity habits (24, 33, 39, 40, 50). After staging, subjects then received the appropriate stage-matched newsletter according to the results of the algorithm survey.

After a subject staged for a particular month, they were permitted to go back and review previous messages, if desired. However, subjects could not go forward in time to a new message unless the next month arrived (i.e., currently viewing October newsletter, but cannot view November newsletter until after November 1st). At the conclusion of the study, each subject received an opportunity to critique the web site. Upon opening up the last message, subjects were automatically directed to a separate site that offered a short exit survey. Questions probed for the utility of the program in improving one's nutrition and physical activity habits and if one would recommend this program to others. Subjects were also given a text box in which they could also provide written comments, if desired. To encourage candid remarks, a special note was mentioned that the survey page was formatted principally for confidentiality, in that responses could not be traced back to the respondent in any manner. See Appendix F for an example of the final newsletter layout design.

<u>Technical Development of the Newsletter Tailoring</u>. A professional web design support firm was contracted to provide technical support in development of the web site.

Essentially, a database-driven, web administrable, site was created by combining the use of Microsoft® Active Server Pages Technology (ASP) and ActiveX® Data Objects (ADO) with a custom designed Microsoft® Access database on a Windows® NT Server (13). The program fundamentally linked newsletter messages from a source file to the results from participant staging algorithm responses. Over 2,500 lines of specific code were written using if-then statements, which supplied the requisite decision rules necessary for displaying the appropriate newsletter content for a specific stage.

Discussion

Although the focus group data were informative and provided the foundation for developing the intervention, there were some limitations. Only 30 individuals actually participated in the six scheduled group discussions. Krueger (38) recommends that groups number from 8-10 to ensure group dynamics, and keep contacts between participants as anonymous as possible to limit undue influences or pressures. Group size ranged from three to seven which may have resulted in a less than desired level of representation of the target audience. One possible cause for the low participation rate was attributed to a regional military crisis, which occurred during the focus group sessions. This resulted in numbers of personnel from the installation under study being deployed on short notice. Additionally, while the transcripts of the focus group discussions were analyzed by the research investigator, they were not validated by an independent reviewer. However, at the termination of each session, both the moderator and the research investigator summarized the group discussion notes by refining

questioning techniques, acknowledging the salient points, and inferring tentative conclusions.

Development of the newsletter content took considerably longer than anticipated because of the need to create the volume of information required for the intervention. All five stages of the TTM for nutrition and physical activity had to be written. A total of 60 messages were required for building a source file or "library" from which participants read depending on the staging algorithm results. Additionally, while the central themes of the newsletters were to increase fruit and vegetable intake and increase physical activity levels, the extra information on nutrition and physical activity as requested by the focus group participant information was also linked to these themes. Extensive time and effort was undertaken to ensure that the supplementary information requested was presented in a manner appropriate for a particular stage.

Although it is widely accepted that the TTM has a number of constructs that encompass characteristics from other intervention theories, a significant feature of the model recognizes that change is not a linear process. That is, change for most is a spiral pattern where one can move forward, stay stable or regress numerous times. It is a dynamic process where individuals may take several tries before they eventually succeed in adopting the new behaviors consistently (maintenance). Prochaska (47) accentuates the importance of planning for relapse (especially for those in the latter stages who work to prevent relapse), by allowing people to regress if necessary but providing the appropriate stage matched materials to help persons recover and move forward again. *Let's Get Moving* placed greater importance on preventing relapse for those in the latter stages, where according to the focus group data, most were at risk for relapse. However,

a relapse provision was built into the entire program for anyone who recycled back to an earlier stage. Because participants had to "re-stage" themselves each month for the next newsletter, a person that regressed to a lower stage would get information matched for that cognitive state, and ultimately aid the person in getting back to their previous stage and beyond.

Because individuals can be in one stage for one behavior and yet another stage for a different behavior, it was necessary to create a program that accounted for this stage variability (35). In effect, this meant that newsletters had to be written for all five stages of dietary habits and all five stages of physical activity habits. Although this was accomplished, only enough messages were created to fulfill a six-month period to match current USAF programs. Other computer-tailoring research (17, 18, 19, 23) has intervened within shorter periods of time. Nonetheless, how far a person successfully progresses is linked to the stage they were in at the beginning (47). While the majority of the subjects were in the mid to latter stages for both diet and exercise, it will be important to ascertain whether the effects of the intervention will have lasting impact after a six month exposure to web site materials based on the TTM.

Expense associated with the actual development of a web site was considerable and varied among the expertise available. Depending on the size of the web design firm, cost ranged from $100 to $150 per hour. Smaller firms were reluctant to take on the design of this particular project because of the complex demands for lengthy code writing for a myriad of if-then statements. Larger firms provided more flexibility and proficiency in developing the site but were costlier. The main advantage of going through a large firm was receiving a cost estimate for a complete job (versus charging by the hour) and

most importantly, warranting the research at implementation and for the duration of the study. There is also the requirement for a web server to host the site after it is developed. While the USAF could host the web site as developed, difficulties arose from in-place security measures that limited subject access once outside the military domain (such as from their home). Fortunately, the same firm also provided web hosting services for a reasonable fee and was able to offer unrestricted access to the site for subjects possessing the authentic URL, logon and password.

Central to the development of any nutritional education program is ensuring its applicability towards the target population. In this particular situation, working with a highly itinerant military population, it was crucial to generate a program that was accessible world-wide and promoted good nutrition and physical activity habits (two test subjects actually deployed during the intervention period). Hence, it was important to identify the relevant needs of the targeted audience with formative evaluation(s). Using focus group data, an interactive web based program was expressly designed to meet the nutrition education needs of a diverse technical military force, subject to worldwide deployment at a moment's notice. Nearly all Air Force personnel have access to a computer, either sitting on their desk or nearby in their duty area. In the event these individuals deploy to a location other than their home installation, they will have the opportunity to access the program via the world-wide web. The military generally provides computers at most deployed locations for use by active duty personnel. In effect, this program supplied a convenient, highly accessible and self-administered program, which met the demands of current Air Force health promotion efforts.

There is growing interest in developing less intensive but more encompassing and far-reaching health promotion interventions, especially in the managed care environment rapidly expanding within the U.S. and the military. Often known as self-administered interventions, there is a call for use of these types of programs because they enhance reach, efficiency and efficacy of health education efforts as opposed to more intensive and expensive usual care options. Black and Cameron (14), argue there are a number of advantages to using a self-administered approach in a population health approach. Cost is reduced because of less demand placed on the health care provider in administering the program. Lower intervention costs enables the health profession to reach more groups that could be at higher risk for certain diseases. Ability to reach a larger segment of at risk populations is possible with self-administered programs. One may have a high success rate with an intervention but have low participation numbers whereas an intervention that can reach more individuals with a lower success rate can mean more overall impact (100 patients with a 60 percent success equals 60 reached versus 1,000 patients with a 20 percent success equals 200 reached). Potential use of advanced technology in self-administered interventions also augment efficacy rates by faster delivery of health information and quicker modification of intervention content due to recent advances in scientific study.

The use of computer technology in changing health promoting behaviors is one possibility (27). Some have strongly argued for the relative efficacy of using computer tailored health messages in addressing current health problems (or those at risk) in reaching large numbers of individuals. Although many attempts have been made to target populations utilizing mass media campaigns, it has only been in recent times that

computers have been used to motivate people toward healthier lifestyles. Computer tailoring entails "the adaptation of health education materials to one specific person through a largely computerized process. Tailoring refers to the fact that the content of the information is adapted to an individual's characteristics (gained through surveys and questionnaires)" (27).

A review of eight studies (16) which evaluated the utility of using computer generated and tailored messages to promote healthy lifestyles revealed a greater effect over standard health information materials (information that provides general health recommendations for all individuals, regardless of current behavior practices). While considered a promising and potentially unique method in health behavior change efforts, there are a number of aspects of this technique which require further elucidation. For example, one concern deals with the length of the message content. Some research (23) used only a couple of printed pages whereas others (18) have provided more material to read. What is the most effective range and when does it become burdensome? Experimentally, this program's main message was limited to 4-6 pages of content. Effective methods of obtaining feedback is another area which requires exploration. Brug (20) had significant results when using tailored feedback material to impact fat, fruit and vegetable intake. It is unclear by what mechanism the feedback had its effect (repetition of the message itself or the actual tailoring of the message which conforms to the current needs of the individual changing behavior). *Let's Get Moving* participants could verify their progress in grasping the material by taking a quick quiz at the end of the main newsletter message. Denoted as the "Check Your Learning" section, participants got immediate feedback on correct responses with just one click of the

mouse. Furthermore, as participants continued to progress into the program, they were able to go back and visit previously read newsletters to review past material and, most importantly, note their progress (or regression) from the results of the staging algorithm survey for that month.

This experimental program using computers, the Internet, and the TTM is one of the first of its kind for use by military populations. Every attempt was made to assimilate recommendations obtained from previous research to include influencing two or more behaviors to change simultaneously, using valid and objective parameters to measure efficacy besides self-report assessments, provide feedback which compares an individuals current progress with previous efforts, using all pertinent constructs of the TTM, and utilizing the correct staging algorithm to properly categorize individuals. Of utmost importance, however, is the use of theoretical models for application in various health problems (14). Attracting and treating an at-risk population with an appropriate health behavior model is central to the success of any intervention.

Selecting an appropriate theory upon which to base the study on was challenging due to the vast possibilities that exist. Prochaska's TTM was chosen because it incorporates other important singular elements for behavior change from other successful behavior change models. Not only does the model consider the particular motivational stages a person may be in at a given time, it uses the self-efficacy (build confidence for new behavior), decisional balance (increase benefits for new behaviors), and processes of change (raise awareness of problem behaviors, encourage self-evaluation, solicit support from friends and family, avoiding temptation/relapse and practicing new behaviors in a social setting). Whereas other models only consider a few attributes of individual

behavior change, the TTM provides health care professionals more methods to obtain and sustain behavior change (47). A main tenet of the TTM is to treat people with stage appropriate materials based on their cognitive readiness to change. In some cases, there are existing programs to change behaviors that do not take this cognitive readiness into account. TTM proponents argue this is why some continue to fail in spite of intensive efforts. Air Force health promotion interventions generally do not consider a person's readiness to change, but rather treat all individuals the same when found in need of appropriate diet and exercise guidance. Prochaska (49) alluded to this as a possible reason why some individuals do not succeed in changing toward healthier lifestyles. Thus, health professionals need to consider the state of a person's cognitive state to change and then intervene according their particular stage of readiness to change.

It was essential that newsletter content was effective and focused. Again, using data from the focus group analysis and from the literature, each newsletter message was carefully constructed to ensure target audience information desires were met and that the underpinnings of the TTM were kept in place. One of the most difficult aspects of creating the messages was to recall that, although participants wanted to gain more information about a particular subject, the approach in providing that information had to be tailored to the appropriate stage. For example, subjects expressed a desire to become more informed about fat in their diet. Those in the earlier stages of stage (precontemplative, contemplative) received a message which followed Prochaska's emphasis to "raise awareness, personalize the risk, and encourage emotional acceptance of the new behavior," e.g., to reduce their fat intake. Persons in the latter stages (preparation, action and maintenance) had a different strategy applied, namely, to

increase the pros of change, seek others' support, gain confidence in making a change, and practicing the new behavior in society. The important point for both practitioners and researchers is to always keep in mind that in earlier stages, individuals need more motivational slants to the information they are provided as a means of encouraging a commitment towards change. For those in the latter stages, provide the "how-to" type of knowledge they need to further reinforce the changes they are about to make or have already made and require reinforcement.

Focused and flexible, *"Let's Get Moving"* attempted to meet the challenges set forth by the USAF who asked for "more research to determine effective educational methods to translate dietary recommendations into appropriate food choices and sustained behavioral changes for various subpopulations" (11). Undoubtedly, further innovative nutrition education programs will be investigated to promote the health of military personnel and ultimately, enhance our nation's defense.

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CHAPTER 4

IMPROVING NUTRITION AND EXERCISE HABITS IN ENLISTED AIR FORCE MEN: APPLICATION OF THE TRANSTHEORETICAL MODEL AND INTERNET TECHNOLOGY

Introduction

Both government and professional agencies continue to espouse the necessity of practicing good dietary and physical activity habits to sustain health (2, 13, 14, 49). Although some progress has been made in national health objectives, there remains considerable opportunity to improve in terms of increasing physical activity levels, decreasing intake of total fat and saturated fat and increasing fruit and vegetable consumption (14). Physical activity levels are far from acceptable for maintaining good health. Approximately 60 percent of the adult population is inadequately active while another 25 percent has been reported to be completely sedentary (3, 5). Men and women's average intake of fat as a percentage of calories has decreased; however, consumption of total and saturated fat still exceed recommended dietary guidelines (39) and daily servings of fruits and vegetables are below suggested levels for maintaining nutrient adequacy (24, 63, 77).

As an occupational subgroup of the aforementioned population, the military has not been reported on extensively regarding their diet and physical activity behaviors.

This has been largely due to the perception that because the military have stringent weight and fitness standards to meet, all follow prescribed healthy lifestyle recommendations. Yet, some research concerning these and other studied behaviors in military personnel indicate a need for improvement (19). The U.S. Army administered surveys in the 1990s to assess personal health habits in tobacco and alcohol use, physical activity, nutrition and other safety related practices. Given to more than 400,000 soldiers, it made comparisons between those behaviors of the soldiers to that of *Healthy People (HP) 2000* objectives. The Army found that while the soldiers exceeded *HP 2000* goals for physical fitness, eating high fiber foods and using bicycle helmets, they did not meet goals for nutrition, tobacco cessation and seat-belt use (83). A retrospective study (81) of U.S. Army and Marine personnel showed that not quite half of those studied (43 percent) met the minimum recommendation of five daily servings of fruits and vegetables. Although a small study that evaluated the diets of 798 personnel, the data suggest that over half of those eating at military dining facilities did not meet recommended guidelines.

More recent United States Air Force (USAF) and Department of Defense (DoD) studies have shown that military personnel practice unhealthy behaviors which have cost several million dollars in direct health care costs and lost productivity (11, 12, 76). In 1995, an Air Force Behavioral Risk Factor Surveillance Study found that 76 percent of the active duty personnel reported their health as good or excellent and 14 percent had height and weight measurements that yielded a body mass index exceeding Centers for Disease Control and Prevention criteria for recommended health (8). A 1998 DoD survey showed that USAF members have the lowest total involvement in strenuous

physical activity of any of the services (10). These same negative behaviors exhibited in military personnel at excessive rates could result in an unnecessary and unacceptable drain on medical resources, degradation of job performance and, ultimately adversely impact mission accomplishment.

Increasing physical activity levels and improving nutritional habits can take many approaches. Strategies can include interventions that target both education and behavioral change (43, 55). Although past and current studies continue to demonstrate how diet and physical activity separately decrease risk for disease, few examine their synergy as intervention mainstays. Very little has been revealed in terms of evoking change in two or more health behaviors at the same time (55). Some have argued that interventions that attempt to impact multiple risk factors may be overpowering for certain individuals (38, 47). As people age into their middle years, however, they become more cognizant of their health and the behaviors associated with maintaining that health (70). During this part of their lives, their receptiveness for multiple behavior change could increase. Others posit that individuals may possess "gateway behaviors," where one behavior when acted upon, has positive effects on other behavior changes (62). It may be reasonable to further investigate the efficacy of concurrently influencing two behaviors in promoting health education and disease prevention in various stages of adult life.

Applying a theoretical behavioral model to impact nutrition and physical activity patterns is crucial. Behavioral theory can help explain a person's behavior and then provide critical information for building an effective intervention. Key elements of successful behavioral interventions include variables (using data from benchmark studies involving health-related behavior change) that impact behavioral choices (42). It is

important to develop and apply a theory which efficiently explains and aids in the exploration of change across a continuum of behaviors. While there are a variety of theoretical models from which to select, Prochaska's Transtheoretical Model of Behavior Change (TTM) (67, 68) has demonstrated a high degree of effectiveness over usual care treatments (56). Prochaska's TTM was chosen because it incorporates important singular elements of behavior change from several other successful behavior change models. Not only does the model consider the particular motivational stages a person may be in at a given time, it uses self-efficacy (build confidence for new behavior), decisional balance (increase benefits for new behaviors), and processes of change (raise awareness of problem behaviors, encourage self-evaluation, solicit support from friends and family, avoiding temptation/relapse and practicing new behaviors in a social setting) to evoke change in individuals. It has been successfully used in a wide range of health behaviors to include diet and exercise practices (69). Initially used in tobacco cessation therapy (36, 66) the TTM is an amalgamation of tenets from a variety of psychotherapy and behavioral change theories, thus the term "transtheoretical."

Essentially, the premise of the model is that persons engaging in a new behavior transition through five distinct stages (precontemplation, contemplation, preparation, action and maintenance), which predicts readiness to change over time (67). A person in "precontemplation" makes no commitment to change and is essentially unaware or does not acknowledge the problem behavior. Those in "contemplation" are aware of the problem behavior and are considering change within six months, whereas in "preparation" individuals have made a commitment to change in next 30 days. The later stages, "action" and "maintenance," have individuals actively engaging in the new

behavior. The difference between these two stages is the length of time practicing the new behavior; a person in action has done it for less than six months and maintenance is defined as sustaining the new behavior for a length of six months or longer.

A particular important aspect of the model acknowledges that change is not a linear process. Change can be cyclical, advancing and regressing back and forth through each of the stages until maintenance is eventually reached. Further, the model also accounts for the fact that individuals could be in different stages of change and behavior patterns across a variety of health behaviors, i.e., have engaged in positive dietary patterns, but not necessarily sustaining good exercise habits. Processes of change (36), self-efficacy (20), and decisional balance (48) are the additional core constructs of the model and are incorporated from other psychological theories. These represent additional strategies and techniques people use as they progress through the stages. Prochaska and Velicer (68) advise that by using an individualized approach with the TTM, health promotion programs can be designed which are suitable for all.

In terms of reach effectiveness, the worksite setting offers tremendous potential for health promotion programs. The primary objective of health promotion programs is sustaining health and preventing disease through changing negative behaviors (as well as promoting positive ones). While individual benefits are clearly evident from a healthy lifestyle, employers stand to benefit as well. Specifically, advantages can be realized in decreased absenteeism, increased employee recruitment and retention, enhanced worker productivity, and lowering of health care claims and requirements (26). This would be especially true in the military and the USAF where the nation's defense is paramount. Obviously our nation's defense is linked to military troop readiness, which is further

linked to individual health and fitness. Fitness depends on proper dietary and physical activity habits. The United States military establishment ensures a fit and ready force by incorporating fitness and weight standards for its personnel. As a result of Department of Defense (DoD) health promotion directive (1) no. 1010.10, implemented in 1986, every branch of the service has undertaken essential measures to improve and maintain military readiness of all its personnel. This document provided a health promotion template for all the services to follow in terms of ensuring strict adherence to weight and fitness standards. Specifically, six major interest areas were identified by the directive for health promotion: 1) smoking prevention and cessation, 2) physical fitness, 3) nutrition, 4) stress management, 5) alcohol and drug abuse prevention, and 6) early identification of hypertension (1).

As was the case with their civilian counterparts, the DoD medical community has also dealt with upward spiraling medical costs of peacetime health care as a benefit of employment to active duty, retirees and the families of both. The DoD, similar to the private sector, has moved to the managed care arena in an effort to meet increasing medical demands. These programs have health promotion as a central theme towards improving economies and efficiencies within the medical establishment (23, 34).

In response to this directive, each service implemented their respective programs. Within the USAF, efforts to place health promotion efforts at the forefront started with instituting Health and Wellness Centers (HAWCs) at every main installation. These centers underscore the ideals as prescribed by the 1986 DOD directive and provide an essential health promotion asset within the USAF's medical corps. Each HAWC has a myriad of programs and equipment which targets individual health by facilitating the

requisite lifestyle changes for long-term wellness and purposely integrates the total military community to include DoD civilians, retirees and their families. Part of the HAWC's responsibility is to implement and manage an installation wide fitness-testing program for the active duty population. Cycle ergometry is an integral part of the fitness testing program to assess cardiovascular conditioning. Successfully passing this test depends on the level of conditioning one has obtained as well as how much a person weighs for their particular height and gender.

Thus, diet and exercise play an integral role for maintaining USAF fitness standards. Although the majority of active duty USAF personnel successfully pass the ergometry test, there are certain individuals who struggle to pass. Generally, it is found that these individuals do not exercise on a regular basis, nor do they maintain their weight within prescribed standards. Recent data (7) from the Air Force Medical Operations Agency at Bolling Air Force Base, Washington D.C., show that, in 1998, males in the age group 30-44 pass their ergometry test by much smaller margins than other male or female age groups.

Although nutrition and exercise programs exist to assist their individual efforts towards greater physical fitness levels and improved dietary habits, they do not take into consideration the cognitive state of preparedness to change in the individual. In other words, some exercise and nutrition programs are designed for individuals who have made the commitment to be physically active and eat nutritionally balanced meals. Marcus (60) reported that scores on a physical activity behavior survey conducted at a worksite significantly differentiated employees among various behavioral stages of preparedness. According to the literature (47, 60, 67, 68, 73, 74), a more effective approach is to

implement a strategy that uses stage-matched interventions based on the Stages of Change model. In other words, devise programs that correctly identify the particular needs of the individual for the current health behavior exhibited (the stage) and then match the appropriate treatment for the individual in a tailored fashion.

Consequently, the USAF has encouraged new health research initiatives as part of the *2000 Air Force Healthy Communities Research Program* (15). Using the Healthy People 2010 objectives and the previously mentioned DoD directive as a foundation, this program calls for more research pertaining to innovative health promotion and disease prevention methods. Specifically, within the topic areas of "physical activity and fitness" and "nutrition," the Air Force has requested further investigation regarding the:
1) adoption of healthy behavior patterns, including social skills, attitudes and knowledge of adopting regular activity programs, 2) developing effective educational methods to translate dietary recommendations into appropriate food choices and sustained behavioral changes, 3) exploring reasons people change or do not change behavior related to health as a result of exposure to health promotion programs, and 4) study and development of work-site programs and their impact of likelihood to make needed lifestyle changes.

Because of the USAF's reputation as a technologically driven service, it is plausible that the use of computers and the Internet to promote health education efforts would be of great value in terms of reach and effectiveness. Further, due to the paucity of research associated with using the TTM in military populations, additional study would add to the growing research involving this particular behavior change model. Combining both aspects of computer/web technology in concert with the TTM in achieving USAF health promotion objectives is clearly warranted.

A twofold study, this paper reports findings regarding a military health promotion intervention program, *"Let's Get Moving!"* which used Internet technology to disseminate diet and physical activity information based on the TTM. The first part of the study entailed the design and development of the program and is reported elsewhere (80). The purpose of the intervention was to improve fitness levels in a study sample of Air Force enlisted men aged 30-44 by changing diet and physical activity behaviors. Because these behaviors are integral components of fitness, both outcomes were assessed through various data collection methods. Whereas earlier TTM research evaluated effects using only self-report measures, this study measured both behavioral and physiological outcomes using combinations of self-report and objective assessment tools.

Methods

Research Design. Using a randomized controlled intervention design, this study evaluated the effectiveness of an experimental health promotion program for USAF personnel. Approval was obtained from the United States Air Force Academy Institutional Review Board and the Colorado State University Human Research Committee and each subject was provided informed consent (Appendix G). Subjects were male active duty military personnel from Peterson Air Force Base, Colorado Springs, Colorado, and were recruited through a combination of advertisements, referrals and personal contact. Forty-six individuals volunteered to participate in the study and did not receive any incentives. Criteria included male gender, enlisted, between the ages of 30-44, not enrolled in any mandatory fitness or weight management program and have at least one year of retainability of active military service. Those with known health

conditions requiring medication that could alter plasma lipid levels or cardiac function were not permitted to enter the study. Four individuals were excluded during the screening process.

Originally, 42 subjects were randomly assigned to either a treatment (access to web site containing health promotion information) or control group (no access to web site) for a period of six months. However, three study participants withdrew due to unforeseen medical and duty reassignment reasons, leaving a final study total of 39 (19 control, 20 treatment). Subject demographic characteristics including age, ethnicity, rank, time in service, education, family history of chronic disease and tobacco use were collected. Demographic frequencies for variables were similar between groups (Table 4.1). Those in the treatment group were required to visit the web site at least once each month to view the messages but encouraged to re-visit as needed for reviewing current or past information on diet and exercise. To avoid possible cross contamination effects, the web site was secured using encryption methods which required a password for access.

Table 4.1. Baseline Demographics of Study Participants.

Demographic	Control n=19	Treatment n=20
Age (yr)	35.9 (±3.2)	36.8 (±4.0)
Caucasian (%)	78.9	80.0
Non-Caucasian (%)	21.1	20.0
Senior NCO† (%)	63.2	55.0
NCO† (%)	36.8	45.0
Years Service (yr)	15.7 (±3.3)	16.4 (±4.1)
Tobacco Use (%)	15.8	10.0
Family History of Disease§ (%)	42.1	40.0

†NCO denotes non-commissioned officer ranks, senior NCO ranks include more advanced leadership positions from E-7 to E-9. NCO ranks are considered E-5 to E-6.

§History of cancer, diabetes, or cardiovascular disease.

Intervention. *Let's Get Moving!* was a six-month experimental health promotion program which provided diet and physical activity information tailored to an individual's readiness for change to a new positive behavior. Located on an Internet web site for worldwide accessibility and convenience, the program was developed as an intervention to enhance fitness and military readiness. At onset of the study, the treatment group was provided instructions on use of the site. Additionally, each subject was provided a universal resource locator (URL) address and a password with which to access the site during the study period. Those in the treatment group were responsible for viewing separate newsletter messages on diet and physical activity once each month, for a period of six months. Upon successfully logging onto to the web site, each subject viewed a welcome screen where they were required to complete a survey (staging algorithm) to stage themselves for a particular category according to their diet and their physical activity habits. Staging was critical for effectively categorizing a subject in terms of their preparedness to engage in positive nutrition and physical activity habits. Once staged, subjects then received the appropriately tailored newsletter content (one for diet, one for physical activity). Each newsletter contained four separate subsections of information which subjects were asked to read and understand. While the newsletters were designed to take approximately 30 minutes to view per month, individuals were encouraged to take additional time to revisit the site and review previous newsletters and their content.

The first part of a newsletter contained a message regarding a topic in diet and physical activity. These messages contained the main idea of the newsletter to facilitate behavior change. The second and third sections were used to reinforce the main idea through feedback (use of short quizzes) and intriguing thought-provoking facts related to

the original message. The last section incorporated ancillary hyperlinks as a final opportunity to aid subject behavior change through obtaining reputable information from government and professional diet and exercise web sites (see Appendix F for web site format example) on a particular topic area of interest in a given month. Some 300 sites were reviewed and entered into a database to be accessed for additional information.

To further personalize the site and make it more interactive, a link was added to the welcome page that provided direct e-mail capability to the lead research investigator. This key feature of the site provided the means to conveniently answer more specific health concerns from subjects and aid them in expediently resolving any technical difficulties with the site. In order to track subjects on their progress through the program, the lead investigator monitored subject use on a periodic basis from a web administrator site. The site listed each subject by name, study entry date, staging category by diet and physical activity behaviors, number of diet and physical activity newsletters read by month, how often diet and physical activity newsletters were accessed, and finally, total time spent reading each diet and physical activity newsletter. This information was especially useful in keeping subjects current in their readings, as some were sent reminder messages to catch up in a certain month.

At the conclusion of the study, each subject received an opportunity to critique the web site. Upon opening up the last message, subjects were automatically directed to a separate site that offered a short exit survey. The questions probed for the utility of the program in improving one's nutrition and physical activity habits, and also asked if one would recommend this program to others. Subjects were also given a text box in which they could provide written comments. To encourage candid remarks, a special note was

mentioned that the survey page was formatted principally for confidentiality, in that responses could not be traced back to the respondent in any manner. Findings regarding the web site monitoring and exit survey results are reported elsewhere (80).

Measures Used. Behavioral self-reported data were collected from all subjects using self-administered survey and interview techniques. These included assessments for demographic information (Appendix H), dietary intake (Appendix I), and physical activity level (Appendix J). Additionally, staging algorithms (Appendix A) for both dietary and physical activity were used to survey, and categorize subjects (as well as track movement through the five stages) within the previously mentioned five stages of behavior change. Dietary intake was measured with a previously validated and tested food frequency questionnaire (FFQ) (25). An optically scannable questionnaire was designed to measure nutrient consumption across a wide spectrum of foods and to specifically asses total calories, fat (polyunsaturated, PUFA, monounsaturated, MUFA) and saturated fat (SFA) as a percent of calories, grams of fiber per day, and daily servings of fruits and vegetables. Physical activity levels (energy expended) were assessed using a 7-day physical activity recall (PAR) questionnaire (21) previously employed in other studies involving physical activity promotion (31, 56, 64). Stage of change algorithms used to stage subjects for physical activity and diet were adapted from previous research (33, 51, 57, 59).

Physiological data were collected through anthropometric assessment, blood cholesterol profiles, submaximal cycle ergometry testing and blood pressure readings. Body fat percentages were derived from circumferential taping methods in accordance with Air Force Instruction 40-502 (9). Body Mass Index (BMI) was derived from height

and weight measurements. Changes in plasma cholesterol levels (lipid panels which included total cholesterol, LDL-C, HDL-C, and triglyceride levels) were monitored with blood draws at the Peterson Air Force Base Clinic laboratory. Analyses were accomplished using Johnson and Johnson Clinical Chemistry Products and the Ortho-Diagnostic Vitros 250 (dry slide methodology) analyzer (Eastman Kodak Co, Rochester, New York). Upon obtaining cholesterol and triglyceride levels, both HDL and LDL cholesterol values were derived (40). To measure cardiorespiratory fitness, the Monark 818E cycle was used to estimate maximum oxygen consumption VO_2 in subjects (61). All fitness tests were conducted in accordance with Air Force Instruction 40-501 (6) using trained and certified fitness technicians at the Peterson Air Force Base Health and Wellness Center. Systolic and diastolic values were determined by automated sphygmomanometer readings. All behavioral and physiological data were collected at both pre- and post-intervention and are presented as mean ± standard deviation (adjusted means are presented as mean ± standard error).

Statistical Methods

The primary outcome in this study was improvement in treatment group VO_2 score. Changes in the aforementioned behavioral and physiological components (increase in fruit and vegetable intake, decrease in total blood cholesterol, etc.) were included as secondary outcomes. A sample size of 46 randomized subjects was estimated to provide 90% power to detect a mean between group difference of 5 ml/min/kg in VO_2 scores.

For the primary and secondary outcomes, Analysis of Covariance (ANCOVA) was used to compare mean post-test scores, adjusting for pre-test score. Initially, ANCOVA models with a pre-test by group interaction were fit. However, models were simplified by dropping the interaction term, when not significant ($p \geq 0.05$). In ANCOVA models without interaction, post-test scores, adjusted to mean pre-test values, were compared (using the LSMEANS statement in PROC GLM of the SAS software package, version 8.1, 1999, SAS Institute, Cary, North Carolina). When the interaction was significant, the relationship was examined by graphically studying slopes of the lines, post- versus pre-test separately by group. Some outcomes were transformed to log scale in order to meet normality and homoscedastic error assumptions. Additionally, change scores were compared by group with independent sample t-tests as a comparison to the ANCOVA models.

A conservative approach was taken for reporting significant tests. All tests were two sided and outliers were removed only if the significance of the result was affected. Specifically, if an outlier lowered p-values to a value lower than 0.05 in the ANCOVA, the data point was removed.

For demographic analyses, categorical baseline data demographic variables were compared by group using the χ^2 test (for homogeneity of proportions). The χ^2 test was also used to compare pass/fail rates for fitness testing. Because of the small sample size, Fischer's Exact Test was used to derive p-values. Continuous baseline demographic variable means were compared by group using an independent sample t-test (age, years of service). In stage of change analysis χ^2 tests were used to compare (1) initial stage of change by group and (2) final stage of change by group. Independent sample t-tests were

used to compare mean differences in stage progression (progressed, stable, regressed) between groups.

Results

Of the total number of 42 subjects who volunteered for enrollment, 39 (93%) initiated and completed the study. However, sample size decreased at post-study for bike and blood lipid variables due to subject non-compliance, which reduced statistical power to 0.80. Mean pre- and post-intervention scores and subsequent tests by group for the physiological and behavioral variables are presented in Table 4.2 and Table 4.3. Pre-test, post-test, differences in scores are presented as mean ± standard deviation and post-test adjusted scores are provided as standard error (s.e.). P-values for the respective statistical analyses are denoted in the columns marked as t-test, ANCOVA interaction and ANCOVA. When the ANCOVA interaction was significant, no p-value for the treatment effect was reported because the size of the treatment effect depends on the pre-test score. Both groups exhibited similar characteristics at baseline with the exception of total and HDL cholesterol values which were of borderline significance.

Results for the outcome variables are provided in two sections for clarity purposes. The first section details intervention effects analyses. Differences in both physiological and behavioral variables from baseline to post-intervention period are compared for control and treatment groups. In the second section, analysis of stage progression. i.e., the effectiveness of the intervention to facilitating behavior change, is presented. Both groups are compared relative to their readiness to change diet and exercise habits toward more positive behaviors (by stage movement).

Table 4.2 Summary Statistics for Physiological Variables after Six Months Intervention.

Variable	Control *(mean±SD)*	Treatment *(mean±SD)*	Independent Sample t-test p-values	ANCOVA Interaction p-values	ANCOVA Treatment p-values**
1. Weight (kg)	n=19	n=20			
Pre-test	87.5 (±14.3)	85.6 (±11.6)	p=.6549		
Post-test	88.5 (±14.9)	83.4 (±11.6)	p=.2364		
Difference	*+1.0 (±3.3)*	*-2.2 (±2.6)*	*p=.0016*		
ANCOVA post-test adj means (±s.e.)	87.5 (±0.69)	84.3 (±0.67)		p=.5572	p=.0018
2. BMI (kg/m²)	n=19	n=20			
Pre-test	27.4 (±3.7)	26.4 (±2.9)	p=.3755		
Post-test	27.7 (±3.9)	25.7 (±3.3)	p=.0774		
Difference	*+0.3 (±2.1)*	*-0.7 (±1.6)*	*p=.0018*		
ANCOVA post-test adj means (±s.e.)	27.2 (±0.22)	26.2 (±0.21)		p=.3647	p=.0019
3. Body Fat (%)	n=19	n=20			
Pre-test	21.4 (±5.6)	21.3 (±4.6)	p=.9418		
Post-test	22.0 (±5.8)	19.8 (±4.4)	p=.1784		
Difference	*+0.6 (±1.3)*	*-1.5 (±1.8)*	*p=.0004*		
ANCOVA post-test adj means (±s.e.)	21.9 (±0.39)	19.8 (±0.38)		p=.3259	p=.0004
4. Waist-to-Hip (in/in)	n=19	n=20			
Pre-test	0.87 (±.07)	0.86 (±.05)	p=.4907		
Post-test	0.88 (±.07)	0.85 (±.04)	p=.1133		
Difference	*+0.01 (±02)*	*-0.01 (±02)*	*p=.0026*		
ANCOVA post-test adj means (±s.e.)	0.87(±0.004)	0.85(±0.004)		p=.2718	p=.0024

† Denotes borderline significant difference at pre-test.
** Treatment p-values for model w/o interaction, not reported when interaction is significant.
Adjusted means presented as mean ±SE, all other means are presented as mean ±SD

Table 4.2 Summary Statistics for Physiological Variables after Six Months Intervention. **(Continued)**

Variable	Control *(mean±SD)*	Treatment *(mean±SD)*	Independent Sample t-test p-values	ANCOVA Interaction p-values	ANCOVA Treatment p-values**
5. Sys BP (mm Hg)	n=19	n=20			
Pre-test	127.2 (±11.3)	126.3 (±11.7)	p=.7964		
Post-test	128.9 (±12.2)	123.3 (±8.7)	p=.1034		
Difference	*+1.7 (±10.0)*	*-3.0 (±9.6)*	*p=.1451*		
ANCOVA post-test adj means (±s.e.)	128.7 (±1.95)	123.6 (±1.90)		p=.3182	p=.0689
6. Dias BP (mm Hg)	n=19	n=20			
Pre-test	81.1 (±7.8)	78.3 (±10.5)	p=.3518		
Post-test	81.4 (±9.2)	75.1 (±5.4)	p=.0149		
Difference	*+0.3 (±4.9)*	*-3.2 (±10.1)*	*p=.1956*		
ANCOVA post-test adj means (±s.e.)	80.1 (±1.35)	75.3 (±1.30)		p=.0022	
7. RHR (bpm)	n=19	n=20			
Pre-test	71.3 (±11.8)	72.1 (±7.9)	p=.8099		
Post-test	72.8 (±10.6)	68.0 (±5.8)	p=.0927		
Difference	*+1.5 (±9.8)*	*-4.1 (±8.0)*	*p=.0566*		
ANCOVA post-test adj means (±s.e.)	72.9 (±1.64)	67.8 (±1.6)		p=.2600	p=.0309
8. Bike Score (ml/kg/min)	n=15	n=16			
Pre-test	36.1 (±7.9)	37.3 (±9.9)	p=.7329		
Post-test	36.5 (±7.4)	37.8 (±6.0)	p=.6810		
Difference	*+0.4 (±5.2)*	*+0.5 (±5.5)*	*p=.9591*		
ANCOVA post-test adj means (±s.e.)	36.9 (±1.05)	37.4 (±1.01)		p=.2759	p=.7103

† Denotes borderline significant difference at pre-test.
** Treatment p-values for model w/o interaction, not reported when interaction is significant.
Adjusted means presented as mean ±SE, all other means are presented as mean ±SD

Table 4.2 Summary Statistics for Physiological Variables after Six Months Intervention. **(Continued)**

Variable	Control *(mean±SD)*	Treatment *(mean±SD)*	Independent Sample t-test p-values	ANCOVA Interaction p-values	ANCOVA Treatment p-values**
9. Total Chol (mg/dl)	n=15	n=14			
3 outliers removed					
Pre-test	188.9 (±43.2)	195.1 (±37.5)	p=.6840		
Post-test	182.8 (±45.3)	180.0 (±26.6)	p=.8396		
Difference	*-6.1 (±20.7)*	*-15.1 (±28.1)*	*p=.3323*		
ANCOVA post-test adj means (±s.e.)	185.6 (±5.43)	178.5 (±5.63)		p=.0308	p=.3881
10. LDL Chol (mg/dl)	n=13	n=14			
2 outliers removed					
Pre-test	108.5 (±27.9)	114.1 (±35.3)	p=.6487		
Post-test	101.5 (±26.8)	104.4 (±23.7)	p=.7686		
Difference	*-7.0 (±13.9)*	*-9.7 (±22.8)*	*p=.7075*		
ANCOVA post-test adj means (±s.e.)	103.4 (±4.27)	102.7 (±4.11)		p=.1103	p=.9064
11. HDL Chol (mg/dl)	n=15	n=14			
Pre-test †	44.3 (±9.9)	52.3 (±13.3)	p=.0755		
Post-test	43.0 (±11.1)	50.6 (±14.8)	p=.1300		
Difference	*-1.3 (±8.3)*	*-1.7 (±13.2)*	*p=.9138*		
ANCOVA post-test adj means (±s.e.)	45.7 (±2.79)	47.7 (±2.89)		p=.6692	p=.6198
12. Triglycerides (mg/dl)	n=15	n=14			
3 outliers removed					
Pre-test	128.9 (±55.8)	142.2 (±71.2)	p=.5775		
Post-test	140.1 (±74.8)	125.7 (±55.8)	p=.5635		
Difference	*+11.2 (±57.9)*	*-16.5 (±38.7)*	*p=.1438*		
ANCOVA post-test adj means (±s.e.)	144.9 (±12.3)	120.6 (±12.7)		p=.5046	p=.1845

† Denotes borderline significant difference at pre-test.
** Treatment p-values for model w/o interaction, not reported when interaction is significant. Adjusted means presented as mean ±SE, all other means are presented as mean ±SD

Table 4.3 **Summary Statistics for Behavioral Variables after Six Months Intervention (self-report data).**

Variable	Control *(mean±SD)*	Treatment *(mean±SD)*	Independent Sample t-test p-values	ANCOVA Interaction p-values	ANCOVA Treatment p-values**
1. Calorie Intake (kcal/day)	n=19	n=20			
Pre-test	1952 (±961.2)	2179 (±1047.7)	p=.4860		
Post-test	1711 (±874)	2088 (±930)	p=.2012		
Difference	*-241 (±352)*	*-91 (±740)*	p=.4233		
ANCOVA post-test adj means (±s.e.)	1796 (±121.22)	2006 (±118.13)		p=.2500	p=.2240
2. Calories Expended (kcal/day	n=18	n=19			
2 outliers removed					
Pre-test	3129 (±584.6)	3157 (±335.1)	p=.8616		
Post-test	3252 (±666.3)	3481 (±642.3)	p=.2943		
Difference	*+123 (±404.3)*	*+324 (±569.9)*	p=.2259		
ANCOVA post-test adj means (±s.e.)	3265 (±118.26)	3469 (±115.1)		p=.9630	p=.2252
3. Fat Intake (grams/day)	n=19	n=20			
Pre-test	78.3 (±47.9)	86.9 (±45.8)	p=.5677		
Post-test	70.6 (±41.5)	77.4 (±42.8)	p=.6160		
Difference	*-7.7 (±16.1)*	*-9.5 (±35.9)*	*p=.8392*		
ANCOVA post-test adj means (±s.e.)	73.8 (±5.82)	74.3 (±5.68)		p=.2941	p=.9454
4. MUFA (grams/day)	n=18	n=19			
2 outliers removed					
Pre-test	25.8 (±12.7)	29.8 (±14.0)	p=.3658		
Post-test	24.1 (±10.9)	28.3 (±16.2)	p=.3582		
Difference	*-1.7 (±5.8)*	*-1.5 (±12.4)*	*p=.9445*		
ANCOVA post-test adj means (±s.e.)	25.6 (±2.23)	26.7 (±2.17)		p=.9689	p=.7177
Percent of kcal					
Pre-test	11.8%	12.3%			
Post-test	12.7%	12.2%			

** Treatment p-values for model w/o interaction, not reported when interaction is significant. Adjusted means presented as mean ±SE, all other means are presented as mean ±SD

Table 4.3 Summary Statistics for Behavioral Variables after Six Months Intervention (self-report data). **(Continued)**

Variable	Control (*mean±SD*)	Treatment (*mean±SD*)	Independent Sample t-test p-values	ANCOVA Interaction p-values	ANCOVA Treatment p-values**
5. PUFA (grams/day)	n=19	n=20			
Pre-test	18.2 (±10.3)	21.4 (±10.8)	p=.3449		
Post-test	16.6 (±8.1)	20.5 (±13.0)	p=.2691		
Difference	*-1.6 (±5.0)*	*-0.9 (±7.9)*	*p=.7589*		
ANCOVA post-test adj means (±s.e.)	17.9 (±1.51)	19.2 (±1.47)		p=.1931	p=.5790
Percent of kcal					
Pre-test	8.4%	8.8%			
Post-test	8.7%	8.8%			
6. SFA (grams/day	n=19	n=20			
Pre-test	24.1 (±15.3)	25.3 (±12.7)	p=.8032		
Post-test	20.8 (±13.3)	21.4 (±11.4)	p=.8934		
Difference	*-3.3 (±5.3)*	*-3.9 (±10.4)*	*p=.8252*		
ANCOVA post-test adj means (±s.e.)	21.2 (±1.69)	20.9 (±1.65)		p=.1597	p=.9129
Percent of kcal					
Pre-test	11.1%	10.5%			
Post-test	10.9%	9.2%			
7. Fat % of Energy	n=19	n=20			
Pre-test	35.2 (±7.1)	35.6 (±6.4)	p=.8321		
Post-test	36.7 (±7.2)	32.3 (±7.6)	p=.0691		
Difference	*+1.5 (±6.9)*	*-3.3 (±5.1)*	*p=.0043*		
ANCOVA post-test adj means (±s.e.)	36.9 (±1.14)	32.1 (±1.11)		p=.6093	p=.0044

** Treatment p-values for model w/o interaction, not reported when interaction is significant.
Adjusted means presented as mean ±SE, all other means are presented as mean ±SD

Table 4.3 Summary Statistics for Behavioral Variables after Six Months Intervention (self-report data). **(Continued)**

Variable	Control (*mean±SD*)	Treatment (*mean±SD*)	Independent Sample t-test p-values	ANCOVA Interaction p-values	ANCOVA Treatment p-values**
8. Dietary Chol Intake (mg/day)	n=19	n=20			
Pre-test	280.4 (±150.3)	273.4 (±161.5)	p=.8907		
Post-test	246.1 (±191.7)	220.5 (±141.3)	p=.6368		
Difference	*-34.3 (±107.5)*	*-52.9 (±94.3)*	*p=.5678*		
ANCOVA post-test adj means (±s.e.)	242.4 (±22.45)	222.9 (±21.88)		p=.1044	p=.5461
8. Dietary Chol Intake (mg/day)	n=19	n=20			
Log Transformation					
Pre-test	5.48 (±0.59)	5.45 (±0.50)	p=.8778		
Post-test	5.25 (±0.74)	5.24 (±0.55)	p=.9624		
Difference	*+0.23 (±0.41)*	*-0.21 (±5.1)*	*p=.8862*	p=.0524	
9. Fiber Intake (grams/day)	n=19	n=20			
Pre-test	15.5 (±8.7)	17.9 (±10.4)	p=.4413		
Post-test	14.0 (±6.9)	21.2 (±11.9)	p=.0278		
Difference	*-1.5 (±4.3)*	*+3.3 (±7.3)*	*p=.0183*		
ANCOVA post-test adj means (±s.e.)	15.1 (±1.35)	20.3 (±1.32)		p=.2166	p=.0097
10. Fruits/Vegetable Intake (servings/day)	n=18	n=17			
4 outliers removed					
Pre-test	3.8 (±1.9)	4.1 (±2.6)	p=.6813		
Post-test	3.7 (±2.4)	5.2 (±2.3)	p=.0768		
Difference	*-0.1 (±1.6)*	*+1.1 (±1.8)*	*p=.0629*		
ANCOVA post-test adj means (±s.e.)	3.8 (±0.39)	5.0 (±0.40)		p=.4233	p=.0385

** Treatment p-values for model w/o interaction, not reported when interaction is significant. Adjusted means presented as mean ±SE, all other means are presented as mean ±SD

Intervention Effects Analyses. There was no evidence that treatment group exposure to the web site was effective in increasing VO_2 scores. Adjusting for pre-test score, the post-test mean difference between groups was negligible (0.5 ml/kg/min) and insignificant (Figure 4.1) (mean difference 95% CI –3.85, 4.05). When evaluated for pass/fail success rates (Table 4.4), the treatment group had a slightly, but insignificantly, (χ^2 =0.44, p=.5996) higher passing percentage rate at 94 percent (1 failure out of 16), whereas the controls were nearly as successful at 87 percent (2 out of 15 failed). Interestingly, four subjects out of the total sample were enrolled in self-paced improvement programs as a result of initial fitness test failures (identified by asterisk). Of the two in the control group, both improved their fitness levels by an average of 16.7 percent while those in the treatment group improved their scores by an average of 29.3 percent. It should be noted, however, that adequate statistical analysis of this observed effect could not be carried due to the very small size of this sub-sample.

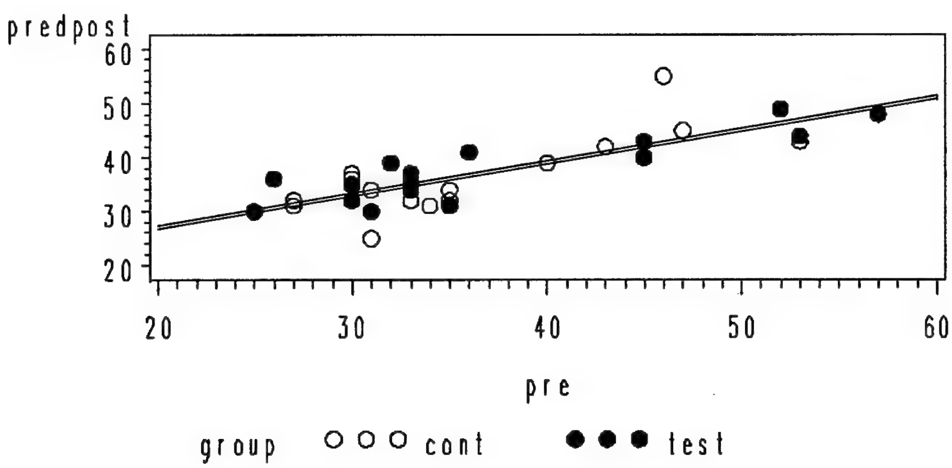

Figure 4.1 Observed VO_2 fitness level scores (ml/kg/min) at pre- versus post-study by group. Predpost denotes predicted values shown by lines on the graph as compared to observed values. ANCOVA treatment group p-value=.7103.

Table 4.4. Fitness Test Pass/Fail and Change in Score.

CONTROLS	P	F	Change		TREATMENT	P/F	F	Change
Subject 1	√		-2		Subject 1	√		+7
Subject 2	√		-1		Subject 2	√		+2
Subject 3	√		+3		Subject 3	ND	ND	ND
Subject 4		√	-3		Subject 4	√		+5
Subject 5	√		-1		Subject 5	√		-9
Subject 6	√		+6		Subject 6	√		+5
Subject 7	ND	ND	ND		Subject 7**		√	+5
Subject 8	ND	ND	ND		Subject 8	ND	ND	ND
Subject 9	√		+9		Subject 9	ND	ND	ND
Subject 10	ND	ND	ND		Subject 10	√		+4
Subject 11	√		-10		Subject 11	√		-9
Subject 12	√		-1		Subject 12**	√		+10
Subject 13**	√		+4		Subject 13	√		-5
Subject 14	√		-1		Subject 14	√		-3
Subject 15		√	-6		Subject 15	√		-1
Subject 16	√		+7		Subject 16	√		-2
Subject 17	ND	ND	ND		Subject 17	√		+2
Subject 18	√		-3		Subject 18	ND	ND	ND
Subject 19**	√		+5		Subject 19	√		+1
					Subject 20	√		-4
TOTALS	**13**	**2**	**Mean=+0.4**		**TOTALS**	**15**	**1**	**Mean=+0.5**

ND=no data obtained
Change represents increase or decrease in ml/kg/min of VO_2 score.
** Denotes subject was enrolled in USAF self-paced fitness improvement program.

Although the web site did not appear to have any impact on improving fitness levels, greater effects were observed in the remaining secondary physiological and behavioral outcome variables. ANCOVA analysis (adjusting for pre-test scores) of post anthropometric assessments revealed significant improvement in weight (p=.0018), BMI (p=.0019), percent body fat (p=.0004), and waist-to-hip ratio (p=.0024). Overall, post-test adjusted means revealed treatment group subjects experienced across-the-board

decreases in body composition measurements as opposed to controls which had increases. This anticipated positive result can be attributed to the controlled study conditions where only treatment group subjects received intervention support to improve diet and physical activity behaviors. Supplementary analyses with independent sample t-tests uncovered similar findings such as a significant 2.2 kilogram weight loss observed in the treatment group, providing additional evidence for the positive trends initially revealed by the ANCOVA. This weight reduction was reflected not only in the anthropometric assessments but in other physiological markers as well. Systolic blood pressure (BP) and resting heart rate (RHR) values also fell in treatment group subjects at the completion of the intervention period. Treatment systolic BP declined but was only borderline significant ($p=.0689$). Post-test adjusted RHR was significantly higher ($p=.0309$) in controls by 5.1 beats per minute (bpm).

Observed blood lipid means also improved in the treatment group but not significantly so (with exception of total cholesterol), possibly due to low statistical power to detect group differences. At the end of the intervention period, some subjects did not report to the clinic for their post-study blood cholesterol tests, further reducing an already small sample size. Additionally, blood cholesterol data were highly variable, especially for triglycerides where three treatment subjects had abnormal blood levels (above 350 mg/dl) according to current medical guidelines (17). According to medical personnel at the Air Force clinic, these subjects may not have fasted at least 12-14 hours in compliance with cholesterol testing protocols. As such, these data points were removed from the blood cholesterol statistical analyses. No significant differences were observed between groups for LDL, HDL and triglyceride values. LDL adjusted mean levels were

slightly lower in the treatment group (102.7 mg/dl) but this difference was small and unexpectedly non-significant. HDL levels dropped slightly for both groups from baseline. Post-test adjusted HDL means were higher in the treatment group (47.7 mg/dl) but not significantly so (p=.6198). Triglyceride levels decreased in the treatment group (120.6 mg/dl) at post-study as compared to controls where levels increased (144.9 mg/dl). However, between group differences for triglycerides were not significant.

Behavioral data were collected by means of self-reporting surveys. Physical activity levels as captured by the PAR questionnaire revealed web site users did increase their energy expenditure. After adjustment for pre-test scores, treatment group subjects reported a mean increase of 204 kcal/day over that reported by controls; however, this amount was not significant (p=.2252). Because of skewness and increasing variance within groups, a log transformation was used but it did not provide any additional evidence for group effect (p=.1656). Two outliers were removed because of suspected errors in self-reporting physical activity routines. Some difficulties occurred with the self-report Food Frequency Questionnaire (FFQ). Unfortunately, nearly half of the total study sample under-reported their caloric intakes (possibly due to social desirability, errors in recalling frequency of food intake or lack of specific types of foods), causing individual nutrient components to be biased downward. According to the U.S. National Health and Nutritional Examination Survey (NHANES) data (16), daily caloric intake, total fat, monounsaturated fats (MUFA), polyunsaturated fats (PUFA), saturated fat, and dietary cholesterol were considerably short of mean U.S. intakes for men of comparable age. However, in comparison to other research (78, 79) with men using the same instrument, researchers reported values close to those found in this study for caloric

intake, fat (percentage of energy), fiber, and fruits and vegetable consumption. In light of these circumstances, caution is advised when comparing some of the FFQ outcome variables with physiological variables earlier reported.

In terms of overall energy intake (total fat, MUFA, PUFA, and saturated fat), both groups had similar post-test values after pre-test score adjustment. No significant differences were found between groups (for MUFA, two outliers were removed in because of possible errors in self-reporting dietary items on the food frequency questionnaire. Reported values did not reflect typical averages determined by national data for U.S. men (16). In some instances, controls had lower adjusted mean nutrient intakes then those in the treatment group (calories consumed, total fat intake, MUFA and PUFA). Treatment group adjusted means were lower than controls, however, for saturated fat and fat calories as a percent of energy. However, saturated fat consumption differences were not statistically significant. There was strong evidence (p=.0044) for a group effect, comparing post-mean (adjusting for pre-test scores) levels of fat as a percent of calories (Figure 4.2). ANCOVA model results for fiber, fruit and vegetable mean intake comparisons were significant for group effect (Figures 4.3 and 4.4). Treatment group subjects who used the web site chose to eat more fruits and vegetables post-study than controls, (post adjusted mean difference of 1.2 servings/day). This increase over controls was moderately significant at p=.0385. Four outliers were removed because values did not reflect national averages for fruit and vegetable intakes (77).

The rise in produce consumption may explain the concomitant increase, also seen with fiber intake in the treatment group, of a post-test adjusted mean improvement of

5.2 grams/day. All tests were significant for fiber intake differences between groups, indicating strong evidence for the web site's effectiveness.

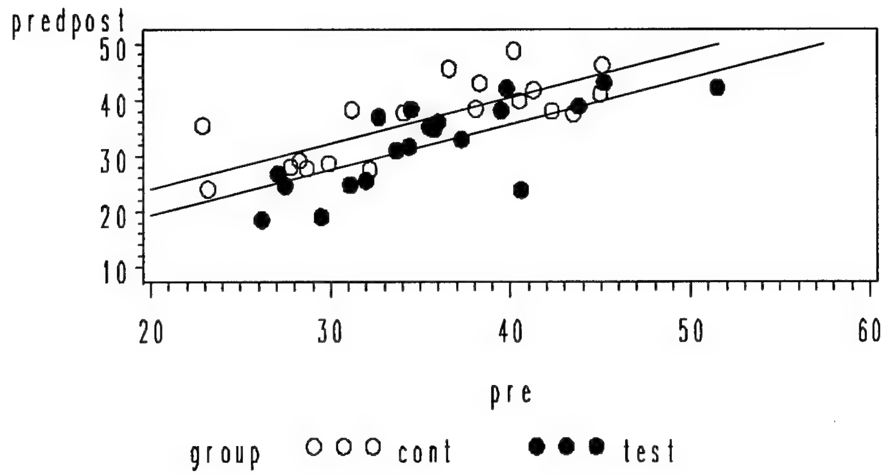

Figure 4.2 Self-reported fat percent of energy scores at pre- versus post-study by group. Predpost denotes predicted values shown by lines on the graph as compared to observed values. ANCOVA treatment group p-value=.0044

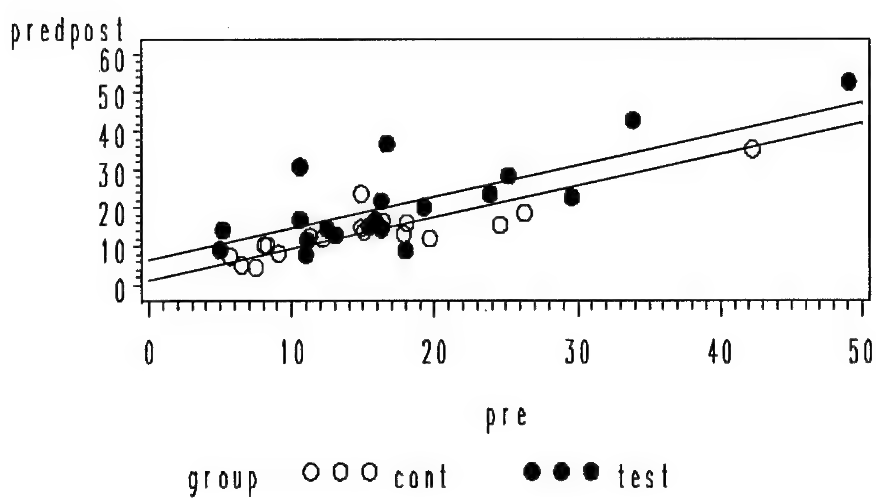

Figure 4.3 Self-reported fiber intake scores (grams/day) at pre- versus post-study by group. Predpost denotes predicted values shown by lines on the graph as compared to observed values. ANCOVA treatment group p-value=.0097

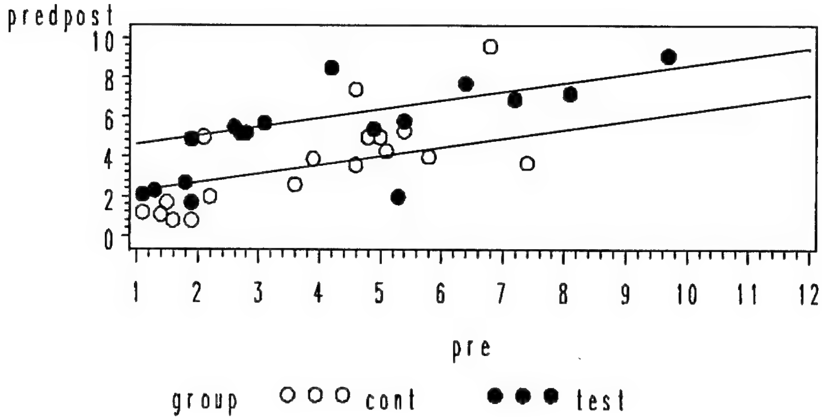

Figure 4.4 Self-reported fruit and vegetable intake scores (grams/day) at pre- versus post-study by group. 4 outliers removed. Predpost denotes predicted values shown by lines on the graph as compared to observed values. ANCOVA treatment group p-value=.0385

For the ensuing discussion, graphs were used for the remaining ANCOVA analyses in which the interaction for pre-test score by group was significant. For example, Figure 4.5 shows a significant pre-test score by group assignment interaction for diastolic BP (p=.0022). The test for equality of the slopes was highly significant, in that the lines were not parallel but different. As seen in Figure 4.5, there appears to be an increasing linear difference and a strong relationship between pre- and post-test scores. More specifically, the data suggest that there is no difference between groups for subjects at low BP pre-test scores but there appears to be a large difference between groups for subjects with higher pre-test BP scores. Further analysis using the LS MEANS statement confirmed a significant difference between groups at pre-test scores of 80 mm Hg or higher (p=.0107). However this result included one mild outlier in the control group, which suggests only moderate evidence for a group difference.

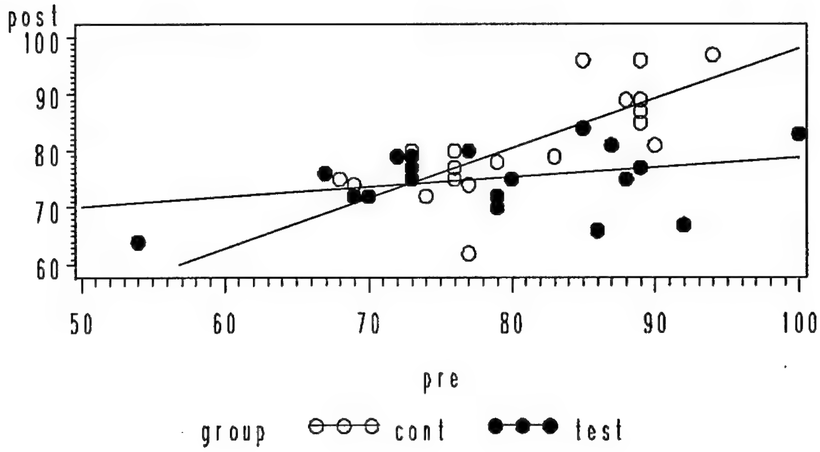

Figure 4.5 Observed diastolic blood pressure (mm Hg) at pre- versus post-study by group. ANCOVA interaction p-value=.0022. Treatment group effect significant at 80 mmHg, p=.0107.

Figure 4.6 shows a significant pre-test score by group assignment interaction for total blood cholesterol (p=.0308). Statistical analysis confirms the observed slopes of the group lines are not parallel, but in fact, significantly different. As seen in the graph there appears to be an increasing linear difference and a relationship between pre- and post-test scores. Among test subjects, at pre-test scores 220 mg/dl or higher, significant differences found between the groups (p=.0463).

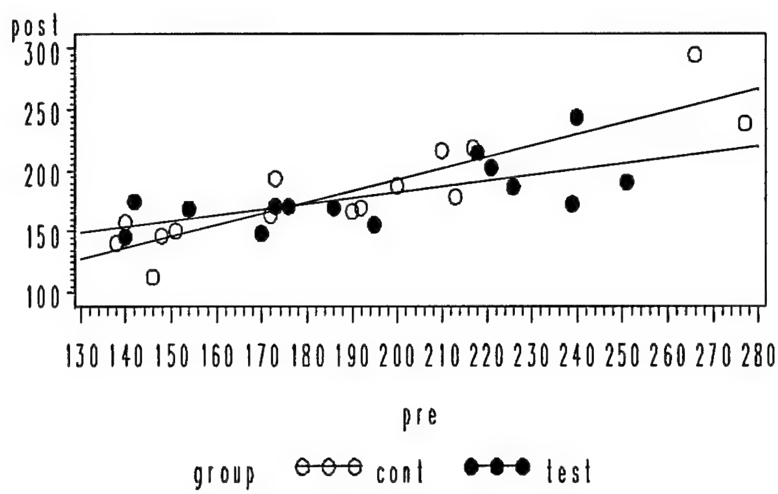

Figure 4.6 Observed Total blood cholesterol (mg/dl) at pre- versus post-study by group. ANCOVA interaction p-value=.0308. Three outliers removed. Treatment group effect significant at 220 mg/dl or higher.

A pre-test score by group effect interaction (Figure 4.7) appeared to approach statistical significance for dietary cholesterol intake (p=.1004). Using a log scale to stabilize variance, the transformation (Figure 4.8) uncovered somewhat stronger evidence for an interaction at p=.0524. However, closer examination of the interaction using the LS MEANS statement determined this difference was only borderline significant at very high pre-test scores beyond 800 mg/dl.

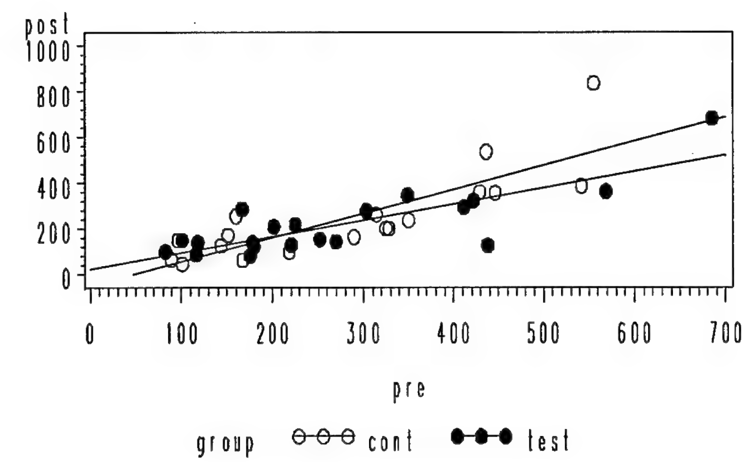

Figure 4.7 Self reported dietary cholesterol intake scores (mg/day) at pre- versus post-study by group, prior to log transformation. ANCOVA interaction p-value=.1044.

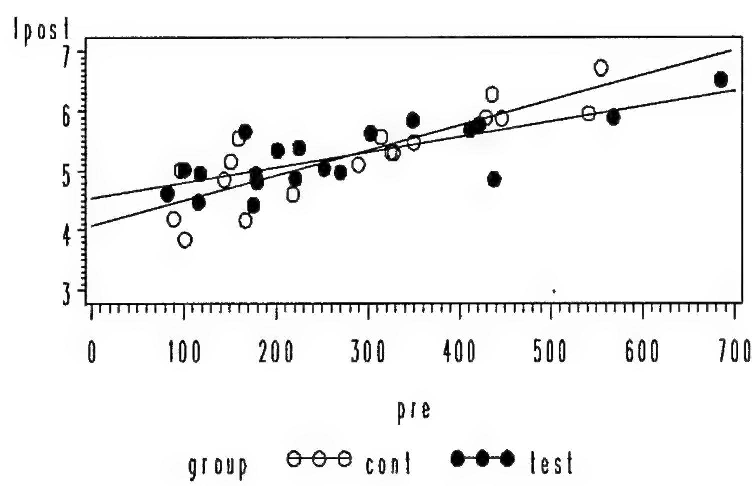

Figure 4.8 Self reported dietary cholesterol intake scores (mg/day) at pre- versus post-study by group, after log transformation. ANCOVA interaction p-value=.0524. Treatment group effect borderline significant at 800 mg/dl, p=.0659.

Stage Movement Analysis. Table 4.5 summarizes the pre- and post-intervention distribution of motivational stages by group. Because of limited number of subjects, stage categories were consolidated into "early" (precontemplation and contemplation) and "late" (preparation, action and maintenance) for the χ^2 analyses. Fischer's Exact Test was used to obtain and report p-values. The relationship between group and stage was not significant at either pre-study (χ^2 =0.36, p=.3008 for diet and χ^2 =0.97, p=1.000 for exercise) or post-study (χ^2 =1.5, p=.2733 for diet and χ^2 =0.0014, p=1.000 for exercise).

Table 4.5. Pre- and Post-Intervention Distribution of Stages by Behavior and Group.

PRE-STUDY						
	Precontemplation	**Contemplation**	**Preparation**	**Action**	**Maintenance**	**Total**
DIET						
Control	4	3	5	4	3	19
Treatment	2	2	10	2	4	20
EXERCISE						
Control	0	0	4	4	11	19
Treatment	1	0	6	4	9	20
POST-STUDY						
	Precontemplation	**Contemplation**	**Preparation**	**Action**	**Maintenance**	**Total**
DIET						
Control	3	3	5	5	3	19
Treatment	2	1	2	7	8	20
EXERCISE						
Control	1	0	4	5	9	19
Treatment	0	1	2	6	11	20

However, by taking each individual subject's progression into account (i.e., did a subject regress, advance or remain stable at post-intervention), a clearer assessment of the web site's efficacy to facilitate positive behavior adoption can be established. Figures 4.9 and 4.10 provide data for numbers of all study subjects, which either regressed, remained stable or advanced to a higher stage at post-study. As can be seen from the table, more

treatment group subjects were observed to have advanced for both diet and exercise than was seen in the controls. For both behaviors, there was evidence that differences in the final stage proportions depended on group (χ^2 =6.6, Fisher's Exact p=.0223 for diet and χ^2 =6.7, Fisher's Exact p=.0281 for exercise). Independent sample t-test for mean stage progression differences between groups, for both diet and exercise were also significant at p=.0284 and p=.0187 respectively. Dietarily, web site users (treatment group) clearly felt confident in thinking about or engaging in new nutritional habits as over half (55%) went on to the next stage of readiness. Similarly, for exercise, while lower, over a third (35%) advanced as compared to the controls where only 16% advanced. Interestingly, a greater proportion of controls fell back into old behaviors (26%); whereas, the treatment group did not experience any relapse. Note that there were greater numbers of web site users electing to positively change their dietary habits in contrast to physical activity (55% versus 35%).

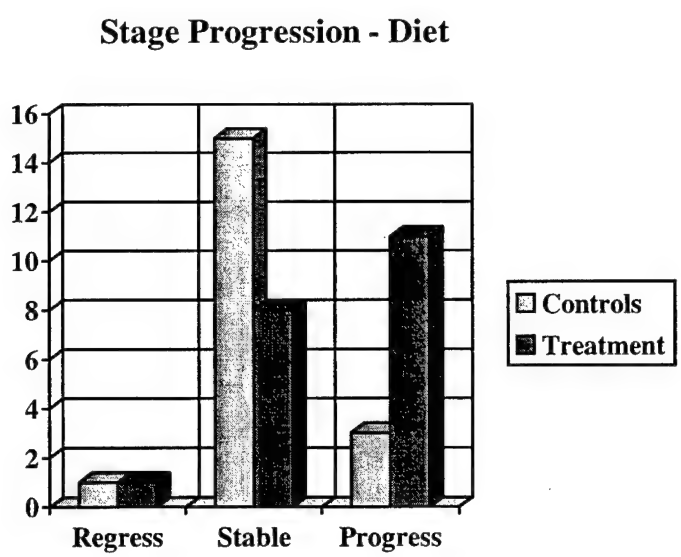

Figure 4.9 Self reported stage progression for dietary behavior by group, post-intervention. Y axis is number of subjects. More treatment subjects reported advancing to new positive behaviors as opposed to controls (χ^2 =6.6, Fisher's Exact p=.02).

Stage Progression - Physical Activity

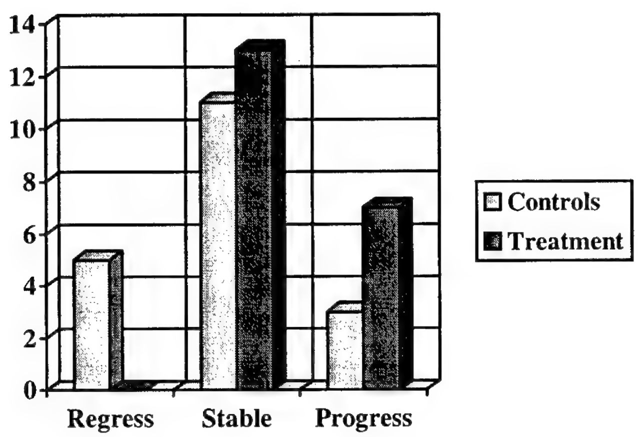

Figure 4.10 Self reported stage progression for physical activity behavior by group, post-intervention. Y axis is number of subjects. More treatment subjects reported advancing to new positive behaviors as opposed to controls. Additionally, 26 percent of control sample reported relapse behaviors as compared to treatment group sample reporting none (χ^2 =6.7, Fisher's Exact p=.03).

Discussion

This research compared the efficacy of using Internet disseminated health information based on the TTM to improve fitness scores in enlisted male USAF personnel. The first of its kind, the research was unique because it evaluated the plausibility of attempting to facilitate change in two behaviors simultaneously using the TTM via the Internet. Further, unlike previous TTM research, results were investigated using both physiological and self report measures. Thirty-nine subjects initiated and completed the six-month study at an operational Air Force installation. The results of this study indicate that the experimental intervention was not successful in significantly increasing fitness scores in web site users. Although treatment group subjects did improve their VO_2 scores, this amount was negligible and was not significantly different from controls. Although too small for adequate analysis, the small sub sample of fitness

test failures did reveal some interesting data in that a higher percentage of improvement for fitness was observed in the web access group.

While the study did not find any effect for improving fitness, it did provide evidence for modest but overall positive effects of using staged matched health information to facilitate behavior change for nutrition and physical activity. Treatment group subjects realized significant improvements in some physiological markers and self-report measures. Additionally, for this study, conservative two-sided statistical analyses were used. In a few variables, one-sided tests could probably be justified and would have improved the level of significance, especially in borderline cases (systolic BP, resting heart rate, fruit and vegetable intake).

These differences observed in the treatment group all took place during times of the year (Thanksgiving, Christmas, etc.) known for weight gain, October through March (82). For most, the holiday periods are typically identified with higher than normal caloric intakes contributing to increases in body weight (72). The positive changes seen indicate that tailored information, when disseminated via the Internet can have favorable effects on both nutritional and physical activity habits, even during the most difficult times of the year. Although the study was limited to enlisted males, this population represents a large segment of the USAF and warrants implementation within USAF health promotion programs.

While the lack of effect on fitness scores was disappointing, it was not surprising for several reasons. First, statistical power to detect differences in VO_2 scores was reduced as a result of subject non-compliance and higher than anticipated sample variability, which increased standard deviation values. Although the intent was to attract

individuals who needed to raise their fitness scores farther above minimum standards, some subjects had high initial scores. As a result, a ceiling effect may have occurred which impacted post-VO_2 scores. Approximately one-third of subjects in each group were well-trained individuals (according to American College of Sports Medicine criteria) with scores above Air Force standards for fitness at pre-intervention. Consequently, these well-trained subjects did not need to elevate their scores, as did their lesser-trained peers. This may have made detecting a treatment effect between groups more difficult because the number of subjects in need of improvement was reduced. The length of the study may also have been too short to see a large effect. Carried out over a six-month period, it is likely that extra time may be needed to generate higher physical activity levels to improve the level of fitness. Two earlier studies (29, 30) using computer-tailored messages to impact physical activity levels reported equivocal results with short time periods as well. Further, as Prochaska cites, change is not a linear process, but rather a spiral, where an individual may take more or less time to engage in a new behavior depending on how many times they relapse. Six months is the minimum amount of time a person may need to consider or practice a new behavior before reaching maintenance (67). The fact that the intervention was low-intensity may also been a factor. Other than the initial meeting to discuss procedures for using the web site and final instructions, subjects using the web site did not attend any mandatory classes or have any periodic individualized counseling which may have prompted increased activity as seen in other high intensity type interventions (41).

It has been reported (37, 55) that certain cognitive-behavioral programs have resulted in small increases in energy expenditure but little has been established on effects

on increasing intensity and duration of exercise. Both are important components for improving fitness levels. Lastly, the study sample was comprised of all self-selected individuals interested in their health. As such, a good portion of the sample was in the advanced stages for physical activity and some had elevated fitness scores at pre-study. Perhaps the exercise information provided, especially written for those in the higher stages was not of value in obtaining the magnitude of change needed to detect differences between groups. Although equivocal results were obtained in this trial, others have reported success using tailored materials, disseminated by other means and used only subjective measures to determine results (53, 54).

In contrast to the fitness score results, certain physiological variables improved significantly over the six-month period. Body weight for the web site users dropped an average of four pounds (2.2 kg) while controls gained an average of 2 pounds (1 kg). This weight loss translated into subsequent improvements in BMI, percent body fat and waist-to-hip ratio, all significantly at $p<.05$. Cardiovascular markers such as mean blood pressure also fell significantly in the treatment group by 3 mm Hg systolic and 3.2 mm Hg diastolic.

Intervention effects on diastolic BP are visible in Figure 4.5. Those subjects needing to improve their diastolic BP (> 80 mm Hg), saw their scores lowered significantly compared to controls. Just as importantly, those treatment subjects with normal diastolic BP (≤ 80 mm Hg), who did not require improvement, had scores stay about the same. In short, the intervention helped those who needed improvement and had no effect on those that did not. Because of the tailored newsletters emphasis on increasing fruits and vegetables in the diet, these results are not surprising, especially in

view of recent data from the DASH studies (18, 45). Results obtained in this study were very similar to those found in the DASH studies for normotensive individuals, after consuming the combination DASH diet (rich in fruits and vegetables, and low-fat dairy foods, and reduced in saturated fat, total fat and cholesterol).

Resting heart rate (RHR) also dropped by over four bpm from baseline. A recent study (44) reiterated the potential for RHR as an independent risk factor for cardiovascular disease, in both younger and middle-aged men and women. Although physical activity levels were not high enough to induce significant changes in VO_2 scores, exercise routines may have been of sufficient intensity and duration to impact RHR levels (22).

Between group differences in blood lipid levels at post- intervention were mixed. Although the treatment group had lowered their total and LDL cholesterol levels from baseline, scores dropped for both control and treatment subjects. Curiously, the combination of encouraging both diet and physical activity habits should have had a much greater impact upon blood lipids as indicated from earlier research (75). Yet as reported by these same researchers, diet alone did not improve blood lipids in any significant fashion. Rather, it took diet and exercise working together in a synergistic effect to result in any measurable differences. It may be possible that the tailored dietary information had more impact, which led to the weight loss and the subsequent anthropometric changes. Perhaps because of the limited impact of the tailored physical activity information (as observed with negligible improvement in fitness scores) to encourage greater activity levels, blood lipid profiles were only moderately affected. A USAF study (41) involving a combined diet and exercise intervention reported significant

reductions in blood lipid parameters for total and LDL cholesterol. However, in this particular research, the intervention was of a more intensive nature with more personnel contact. Another consideration may be that decreases in controls could be the result of taking the pre-study health surveys and blood draws. Although results were not made known to subjects, the mere fact of evaluation may have encouraged some to improve their habits.

The observed decreases in the total cholesterol (significant at 220 mg/dl or higher) and triglyceride (non-significant) means at post-intervention were anticipated, considering the emphasis placed on eating more fruits and vegetables and lowering total fat intake. Treatment group subjects decreased their blood levels of total cholesterol (-15.1 mg/dl) and triglycerides (-16.5 mg/dl) from baseline. Controls also lowered their total cholesterol to a lesser extent (-6.1 mg/dl); however, their blood triglyceride levels increased (+11.2 mg/dl). While differences between groups were not significant, the post-intervention adjusted means were clinical relevant considering the new National Cholesterol Education Program Guidelines (17). Those in the treatment group had cholesterol and triglyceride levels (178.5 and 120.6 mg/dl respectively) well below the "borderline high" threshold for total cholesterol (200 mg/dl) and triglycerides (150 mg/dl) as opposed to controls that approached these values at 185.6 mg/dl and 144.9 mg/dl, respectively.

No improvement was noted for HDL levels in treatment subjects at the end of the intervention. In fact, both groups decreased their HDL levels by a small margin. Although triglycerides, total and LDL cholesterol levels were anticipated to fall with weight loss and exercise, HDL levels were expected to rise in the treatment group given

increased physical activity levels (75). Self-report results from the PAR questionnaire showed treatment group individuals had improved their energy expenditure by over 300 kcal/day as compared to their pre-study levels. Increased blood levels of HDL cholesterol in the treatment group over controls would have lent more objective support to the self-report data from the PAR. As such, it is somewhat difficult to sort out the degree of effect the tailored information had on actually promoting change in physical activity habits. Earlier study by other researchers (41, 52) was unsuccessful in showing exercise effects on raising HDL levels. It may be possible, as was the case with raising VO_2 scores and blood lipids, that a certain amount of physical activity, i.e., frequency, intensity, and duration may be required before any difference in HDL can be realized (41). Again, physical activity messages may not have been of the appropriate content to encourage this required amount of exercise.

With regards to the self-report variables, some either had significant differences or interactions (pre-test by group) between groups. Physical activity expenditure as reported by groups increased from baseline levels. Web site users indicated higher levels than controls but not significantly so. Taking the equivocal fitness score results into consideration, the self reported treatment group increases in energy expended more than likely came from recreational style activities than more intensive type exercise workouts. According to the American College of Sports Medicine, physical activity regimens should be of higher magnitude and intensity to achieve fitness levels beyond health benefits. Taking the combination of frequency, intensity and duration of exercise into consideration, research has shown that any aerobic endurance training taking place less than twice a week, below 55 percent of maximum heart rate, and under 10 minutes of

activity will generally not develop or maintain fitness in healthy adults (65). To truly achieve cardiorespiratory fitness, frequency of training should be at least three to five days of the week, at 65-90 percent of maximum heart rate, and be 20-60 minutes duration, depending on the intensity of the activity (65).

Although the anticipated end point for this study was improved fitness levels, it should be pointed out that the treatment group self reported energy expenditure increases of over 300 kcal/day from baseline. Levels of physical activity necessary to realize specific health benefits have not been fully elucidated, but there is a suggestion that a range of moderate to intense type activities can confer protective effects. According to Haskell (46), "a striking feature of many studies that demonstrate a reduced coronary heart disease risk for more active individuals is that the greatest differences in risk is achieved between those people who do almost nothing and those who perform a moderate amount of exercise on a regular basis." While this sample did not include a completely sedentary population, it is important to note that treatment group reported efforts to become even more active on a recurring basis. The U.S. Surgeon General's report (5), "Physical Activity and Health," cites an increased expenditure of around 150 kcal/day in physical activity (walking, sports, yard work, etc.) appears to be associated with numerous health effects and need not be of high intensity to obtain benefit. It should be clarified this data is based on a few studies and questions remain as to which type of expenditure is important (total amount versus expenditure per unit of body weight). Even so, because web site users were encouraged to increase their moderate type activities, the possibility exists for engaging in other activities that can improve their fitness levels. As Marcus (58) has reported, one of the key determinants of

adult physical activity is self-efficacy. Possessing high confidence to routinely engage in an active lifestyle and enjoy it are critical indicators for current and future exercise behavior.

It is also conceivable that while tailored newsletters were written on both behaviors, apparently one kind of information was better received and acted on then the other. Bull and co-workers (30) found that while computer-tailoring was effective in getting their subjects to increase their daily living activities (yard work, home repair, house cleaning, etc.), they were not successful in producing increases in leisure-type activities (sports, aerobics, weights, etc.)

The group points out the necessity of clearly ascertaining the "key determinants of change" for that precise behavior to obtain a complete appreciation for that individual's lifestyle. If, for example, a barrier to greater fitness levels is the result of single parenting issues, then the tailored information has to address that issue and provide the solution for action. Focus groups were used in this study to capture this type of data to derive the message content. Yet, it appears that certain aspects of the higher intensity exercise messages were not considered useful, and as such, calls for deeper investigation with regard to barriers, motivators, causes of relapse, etc. Kreuter and colleagues (50) also makes the case for thinking beyond just a person's cognitive state for change. In other words, "taking into account contextual, cultural, or personality factors that may directly influence the way a person processes tailored health information or their ability and motivation to make changes that are recommended."

Unfortunately, during the study considerable under reporting was observed with the FFQ survey instrument. Approximately half of the total study sample had unrealistic

intake values for a number of nutrient categories using NHANES data for comparison. This phenomenon occurred across both groups irrespective of age, rank or ethnicity. In certain cases of under reporting, social desirability is usually the reason. Other possible causes include the lack of certain favorite type foods or poor recall of portion sizes/eating patterns. Selection of Block's FFQ was based on to its extensive use in studies involving fruit and vegetable intake (as well as fat) with regard to health and prevention of disease. The instrument was also found valid for use in men of various ages and backgrounds and incorporated the use of portion size pictures to facilitate correct consumption levels. Additionally, the FFQ instrument was chosen over other methods because of study objectives to promote long term dietary changes, i.e., eat more servings of fruits and vegetables on a recurring basis. In essence, the purpose was to capture usual intake over an extended period of time and to account for the seasonality aspect of fruits and vegetables, which affects consumption.

Of the variables self reported, daily caloric intake was somewhat puzzling with a greater decrease seen in the control as compared to the treatment group. With weight loss observed in the treatment group, the opposite should have been true. A possible explanation could be that because the treatment group reported greater physical activity levels post-study, additional calories were used instead of stored. Further, control group under reporting was somewhat higher than that seen in the treatment group. Actual caloric intakes were probably much higher than what was self reported. This was evident when objective measures found controls still managed to gain weight and the PAR questionnaire results revealed small changes in physical activity habits.

Differences between groups with respect to fat energy constituents were mostly non-significant with exception of percent of energy from fat levels. Disappointingly, MUFA and PUFA levels decreased instead of remaining level or slightly rising. In view of the recent guidelines by the various national health organizations (13, 14, 17, 49), greater emphasis is being placed on the use of unsaturated fats, especially monounsaturates to replace saturated fats as a means of moderating plasma LDL cholesterol. Total fat and saturated fat levels were down across both groups with the treatment group showing a marginally greater but insignificant decrease in saturated fat. Of note though were the percentages of each type of fat, relative to total energy intake. Both groups nearly met recommended proportions for the respective types of fat in the diet and generally mirrored NHANES data for men of the same age group. Dietary cholesterol levels for both groups were under national averages (16). Recently announced guidelines (17) advocate a maximum level of 300 mg/day while more stringent levels of 200 mg/day are set for the Therapeutic Lifestyle Changes (TLC) treatment plan for abnormal blood lipid profiles. Although the levels reported by both groups probably do not reflect actual intake, it is notable that both groups did report lower dietary cholesterol intakes, especially in the treatment group.

The final three remaining variables have received considerable attention in recent years as national health objectives (13, 14). Fat as a percent of calories has gone down but is still above recommended levels, while daily intakes of fiber, fruits and vegetables are below par. Intervention messages were tailored to fruit and vegetable intake, but some were devoted to fiber and fat as topics. Despite reporting of low values for the earlier aforementioned nutrients, these last remaining variables appeared to reflect more

representative levels. For instance, fat as a percent of energy intake was close to national averages (16) and at post-study, was significantly lower in the treatment group. This suggests the dietary message for fat in the diet was not entirely missed by the web site users and that the recurring messages to increase fruit and vegetable consumption may have helped to lower fat content in their diets. Although much larger differences were obtained in this study, other TTM interventions with men (27, 32, 78) have reported lowered fat intake percentages as a result of tailored dietary materials. The last variables measured, fiber, fruits and vegetable consumption were all significantly different between groups. Fiber levels rose by 18 percent in the web site group post-intervention and subsequently met current recommendations for daily intake. There was very strong evidence for effect as controls actually lost ground when intake fell back by nearly 10 percent. Interestingly, the amount of fiber increase reported in the web group could translate into approximately one additional serving of either a fruit or vegetable (apple, orange, carrots, broccoli, etc.). This was manifested in the last variable, which assessed daily fruit and vegetable intake. A group effect was evident as web users had a significant increase of slightly more than one serving per day as opposed to controls that essentially remained the same. Again, there is a suggestion that the tailored messages in the web site had an effect in encouraging further daily servings of produce. It is possible that because messages for fruits and vegetables were repetitive throughout the entire six-month period, this had the greatest impact on changing fiber and produce intake behavior. Additionally, as a web site user staged each month, they received immediate verbal feedback on the progress (or lack thereof) they had made.

Brug and colleagues (28, 35) found success using iterative type feedback (progress comparison) in Dutch populations to lower fat intake and improve fruit and vegetable consumption. Although his iterative feedback was more of a quantitative nature, he confirmed previous research which underscored the utility of tailored computer-generated information and that iterative feedback may further augment the effect computer tailoring may have on at-risk populations.

Health education materials were carefully created using the constructs from the Transtheoretical Model of behavior change to specifically tailor information needs with a subject's cognitive readiness to change. It was hypothesized that application of stage matched nutrition and exercise information would result in behavior change. Of interest was whether the web site had any effect in terms of self-reported willingness to improve, as measured by staging algorithms for the five categories of behavior change (precontemplation, contemplation, etc.). Overall, with regard to stage movement, those having access to the tailored web information had significantly greater progression, and less stability and relapsing than those not given access. Initial staging revealed a considerable number of subjects in the more advanced stages for exercise. Although unfortunate from a sampling distribution aspect, this was not particularly surprising. Air Force personnel are required to meet military weight and fitness standards and would have a vested interest in having at least some established exercise practices in place. Obviously, this limits the applicability of the results for those needing more encouragement to become aware or consider a behavior change for physical activity. This could explain the higher amount of stability (65 percent) and the lower advancement (35 percent) observed in the treatment group's stage progression for exercise. Almost

half of the web site group were in maintenance for exercise, while in diet, only about a one-fifth were in maintenance. It is noteworthy that not one subject had relapsed in the treatment group for exercise, whereas in the controls, 26 percent had. An intriguing 16 percent of the controls did advance in both diet and exercise. It is possible when the FFQ and PAR were administered to the controls, it may have prompted some to re-examine their health practices and engage in more positive behaviors.

Limitations concerning this study mainly revolve around sample size and generalizability. Despite the fact that considerable recruiting efforts were undertaken to obtain an adequate sample to retain power, voluntary participation rates were very low. During the time of recruiting for the study, a small regional crisis developed which required certain members of the installation to deploy to outside locations. This strained home unit manning, which increased duty time commitments. This resulted in reluctance of those remaining to devote additional time to outside commitments. Another problem that arose late in the study was non-compliance by some subjects to undergo bike testing and blood draws. This was mostly due to short notice moves to overseas locations and last minute decisions to retire from active duty. Exclusionary criteria were implemented to preclude these circumstances. However, these events were unforeseen.

A specific group of individuals participated in this study, which has generalizability implications. Individuals were men between the ages of 30-44, enlisted and self-selected. Thus, some of the baseline data were not reflective of national averages for men within the civilian population. Additionally, because of the need to meet military weight and fitness standards, subjects were generally interested in nutrition and exercise and may have had some initial motivation for change not typically seen in

the civilian population. This was especially evident in the initial staging for both groups. Exercise had higher numbers for action and maintenance stages and diet had more subjects in preparation, action and maintenance. As such, it is unknown what level of efficacy the web site program has at the lower stages of precontemplation and contemplation for these behaviors. Lastly, the program has obvious minimal personal contact and as such, should be considered a low intensity style of intervention. Health care providers will need to carefully consider whether an individual would be a good candidate for this type of assistance (computer literacy, self-directed, etc.).

Conclusions

In this study, web site users were motivated to either consider or make changes to their existing habits via specifically tailored health information suited to their needs. Using a combination of formative evaluation data, carefully tailored health information based on the TTM and Internet technology, this intervention appears to be an effective tool for the advancement of health promotion for the military. Although fitness scores did not increase significantly in this study, the number of improvements seen in the other variables suggests the web site had impact in getting individuals to adopt new health practices. While it is difficult to sort out the amount of influence each type of tailored message (diet versus exercise) had because of the mixed results observed in some of the blood lipids and self report data, these findings substantiate and expand upon earlier TTM research. This experimental intervention has considerable potential for use in USAF health promotion programs. First, it offers convenience and flexibility to users. Because the program is placed on the web, individuals can access the information 24/7 at home or

at work. This is particularly relevant for Air Force populations where considerable shift work is required to meet military operational needs. Second, it can help extend health professional resources by providing tailored information specific to an at risk person's needs. Individual counseling is labor intensive and time consuming. This tailored approach, at the discretion of the health care provider, can be used after some initial counseling to support an individual through a comprehensive program. It essentially frees up the dietitian or exercise physiologist to work with others who may not be suited for this type of intervention and need personal attention. Third, the program helps to extend reach for health promotion efforts for a highly itinerant population. In the event an individual should be recently enrolled in a program and then is suddenly deployed to a new location, efforts can be sustained due to web availability. All the individual needs is access to a computer with Internet connectivity to log on and continue with the program at their convenience.

Recommendations for further study include research with other populations such as younger persons, different ranks or women. These groups also represent substantial portions of the USAF. Additional investigation for web site efficacy in lower-staged samples is clearly warranted. There were insufficient numbers in precontemplation and contemplation for diet and exercise to really draw any conclusions for web effects. Efforts need to be undertaken to persuade "yo-yo" dieters and "part-time" exercisers (i.e., starving before weigh-ins and only working out prior to fitness testing) to embrace full-time, life-long healthful habits. Additionally, serious consideration should be made to intervene with those who fail fitness testing, given the positive effects observed in the sub sample previously mentioned. Finally, it would be of immeasurable value to see if

effects of the program under study persist one year later and to investigate whether greater or more lasting effects are seen if a program lasted one year instead of six months.

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CHAPTER 5

USE OF THE INTERNET IN EVALUATING COMPUTER-AIDED HEALTH PROMOTION INFORMATION

Introduction

Recently, there has been an extraordinary rise in the use of computers and the Internet for obtaining information. According to the U.S. Census Bureau, around 92 million adults have used a computer at work, home or school for a variety of information-gathering purposes. Eight of ten adults who accessed the Internet from a computer at home used it for e-mail or to search for government, business or, health information (3). The demand for health information is expanding rapidly. Results of several surveys undertaken in the past decade suggest that a fairly high percentage of the public wants to understand more about health-related topics. Most want to learn about health risks of diseases, read advertisements for new medical products or learn about new medical research (12).

As a result of the tremendous growth in this area and the potential for fraudulent information and misuse, a committee of experts known as the Science Panel on Interactive Communication and Health has been charged by the Department of Health and Human Services to further evaluate medical concerns and questions that have arisen as a consequence of this burgeoning field of communication technology (29). Many

Americans are turning to the Internet for health information because of a perceived decline in doctor patient relationships and alternative medicine opportunities (32). Additionally, today's health care consumers feel empowered by this access to information and are taking proactive steps in evaluating the type of care available for prevention and treatment (10, 32). The public demand for sources that provide this information is escalating rapidly. Both libraries and hospitals have increased their use of the Internet as a means of accessing and distributing health information to the public (17, 19). Corporations are also recognizing the value of the Internet (to disseminate health education materials) as a cost-effective means to enhance employee productivity and wellness (9). When it comes to health care and promotion, it is estimated that some $36 billon in medical care cost savings could be realized with the increased use of Internet-based information technologies (4).

Even as more individuals are looking for health-related information, increasing evidence from studies of U.S. diet and physical activity habits reveal worrisome trends. Excessive caloric intake, low intake of nutrient-dense foods, and highly sedentary lifestyles continue to be reported (1, 2, 14). Sustained over a lengthy period of time, these negative lifestyle behaviors lead to chronic health conditions that consequently place an inordinate drain on medical resources and greatly magnify medical treatment costs. Ever cognizant of the need to reverse these troubling trends, the health professions community continues to seek effective interventions to reach those at risk. Intensive and tailored personal counseling sessions are often successful but are expensive and time consuming. Large media-style awareness campaigns reach more individuals but are less effective than one-on-one methods due to their generic approach (18). Thus, there is

growing interest in developing less labor-intensive but more effective and far-reaching health promotion interventions such as those involving computer-aided applications and the Internet.

Often known as self-administered interventions, there is a growing need for these types of programs because they enhance the reach, efficiency and efficacy of health education efforts, as opposed to more intensive and expensive individual-care options (5). One type of self-administered intervention uses computer-tailored materials for at-risk populations. Computer tailoring involves a process where health information content is modified to match an individual's specific health information needs (as identified through surveys and questionnaires) (11).

The use of computer tailoring in health promotion has been investigated across a range of behaviors with varying degrees of success (31). Because computer-tailored material has been customized to address specific needs, it contains less redundant content than that found in mass media type health information. Subsequently, individuals find the information more credible, interesting and personally relevant (6, 31). The manner in which computer-tailored materials are disseminated attract further interest. Methods described in the literature (31) include mail, telephone, printouts from computer kiosks in a waiting room, or hand-delivered by a health care professional. However, a more progressive technique could entail use of the World Wide Web. Many have advocated further investigation into the practicality and effectiveness of this technology (8, 13, 20, 21).

To date, little has been reported on the use of the Internet to deliver computer-tailored information. The potential advantages of using this interactive avenue

(in addition to those of computer tailoring) include convenience, flexibility, reach, instantaneous information, and one other key characteristic critical to intervention success, retention (remaining in a program) (20). Convenience and flexibility are important attributes for a health promotion program, especially for a fast-paced society with varying work and family schedules. Individuals can choose the place and time in which to receive their tailored health information. Effectively contacting and treating large numbers of individuals is another attractive feature. One may have a high success rate with an intervention but have low participation numbers; whereas an intervention that can reach more individuals with a lower success rate can provide more overall impact (100 patients with a 60 percent success equals 60 reached versus 1,000 patients with a 20 percent success equals 200 reached) (27).

Use of Internet technology in computer-tailored interventions also augment efficacy rates by faster delivery of health information and quicker modification of intervention content necessitated by recent advances in scientific information. People can get their information in "real time," possibly at a crucial point of behavior change (20). This becomes especially salient for those attempting to maintain participation in a program involving behavior change.

Further, those administering the program can also use the Internet to observe use of the tailored web-based materials and obtain invaluable feedback from surveys that are provided. This type of program could be of interest in a work site, clinic or community setting where large numbers of individual are in need of personalized health information specific to their needs but resources and schedules preclude counseling or special classes. Obviously, careful consideration of the individual's computer/Internet access and skills

are warranted prior to implementation. However, at the health professional's discretion, they can place at-risk persons within the intervention, and then effectively monitor an individual's progress in moving through the web-based program. Survey results can be employed to refine specific facets of the program and consider their applicability to future users of similar health promotion needs.

Accordingly, this paper details findings regarding the utility of using the Internet as an evaluative tool for computer-aided interventions. The particulars regarding the use of an Internet application to follow an individual's progress are provided, followed by the description of and the results from a short post-intervention exit survey concerning the program participant's opinion of receiving health information via the World Wide Web. Details regarding the design and development of the experimental program and subsequent intervention results are found elsewhere (33).

Methods

Using a randomized controlled intervention design, the study evaluated the effectiveness of an experimental health promotion program for United States Air Force (USAF) personnel. Subjects were male active duty enlisted military personnel from a USAF installation located in Colorado Springs, Colorado, and were recruited through a combination of advertisements, referrals and personal contact. The purpose of the intervention was to improve fitness levels in a study sample of Air Force enlisted men by changing diet and physical activity behaviors via a behavior change model, Prochaska's Transtheoretical Model (TTM) (26, 27). Stage-matched nutrition and exercise information (derived from data obtained in previously completed focus groups) was

provided to each test subject using a newsletter style format. Thirty-nine subjects were randomly assigned to either a treatment (access to web site containing health promotion information) or control group (no access to web site) for a period of six months.

According to the TTM, an individual changes behavior over time, exhibiting certain traits of readiness to change characterized by "stages." The five specific stages include precontemplation (no intention to change in next six months), contemplation (intention to change in next six months), preparation (enacting some of the new behavior and committing to a change in next 30 days), action (fully participating in the new behavior but for less than six months), maintenance (fully participating in the new behavior for more than six months) (25).

Subject needs were determined with the use of two interactive staging algorithms. These algorithms (one for diet and one for exercise) ensured that appropriate individually-matched health information appeared on the computer screen. Separate monthly newsletters on nutrition and physical activity were provided to each individual with access to the web site. Study subjects were required to visit the web site at least once each month to view the newsletters but encouraged to revisit as needed for reviewing current or past information on diet and exercise. To avoid possible cross contamination effects, the web site was secured using clear text encryption methods that required a password for access (available only to the treatment group).

In order to monitor subject access of the web site and its content, a navigational tracking program was established. With each click of the mouse, subject's whereabouts (via Hypertext Transfer Protocol, HTTP requests) for each section of the web site could be followed by name, date, time accessed and total time spent. To ascertain subject

understanding of the main content of each monthly newsletter, a short interactive "quiz" was provided. Limited to three to five questions, this section served to both help reinforce reader comprehension of the material as well as provide another means of showing actual site usage.

Specifically, data were gathered for the average number of times the site was accessed by a subject, average number of minutes spent using the site, and the percentage of correct responses for the interactive testing portion of the site. Calculations for averages were derived by adding the total number of HTTP requests or elapsed minutes for a given stage, month and behavior and dividing by the total number of subjects. Overall averages were derived by adding up each individual value for a given stage and behavior and dividing by six months. A short anonymous exit survey was created for participants to evaluate the web-based materials at the completion of the intervention. Consisting of eight Likert scale-type questions and a text box for written comments, the survey was programmed to automatically appear in the final month's newsletter. Data were obtained concerning participants' opinions of the style, format and efficacy of the site in changing their health habits. The text box provided the means to acquire specific details or recommendations to improve the program not covered by the previous Likert-style questions. To consolidate the data captured from the navigational tracking, an advanced database management tool (22) was utilized which allowed individual queries and tables to be built for data analysis purposes.

Results

Table 5.1 provides the results of how often subjects accessed the site for information in a given month, by stage of readiness to change and behavior (diet or exercise). To fully review each portion of the site, a minimum of six HTTP requests were required. Results for the precontemplative and contemplative stages should be viewed with caution as only a few individuals had staged for those groups. As such, these data are not interpreted.

Table 5.1. Average Hypertext Transfer Protocol (HTTP) Requests for Monthly Newsletters by Stage, Behavior, and Month.

DIET						
Month	Precontemplative	Contemplative	Preparation	Action	Maintenance	No. of Subjects
1	5.5	8.5	8.4	9	9	20
2	5	1.5	7.5	5.6	8.5	17
3	5	1	6.3	5.5	6.5	17
4	5.5	1	7.5	5.3	8.4	17
5	5	4	6	6	7.2	18
6	8	4	6	5.3	6	20
Overall Avg.	**5.7**	**3.3**	**6.9**	**6.1**	**7.6**	
EXERCISE						
Month	Precontemplative	Contemplative	Preparation	Action	Maintenance	No. of Subjects
1	5	NA	8	6.5	8.2	20
2	NA	5	4.7	5.7	6	17
3	NA	5	8	4.2	5	16
4	NA	5	5	4.6	6.1	17
5	NA	5	NA	5.3	6.5	17
6	NA	5	5.3	5	4.6	20
Overall Avg.		**5**	**6.2**	**5.2**	**6.2**	

n=20
NOTE: NA=no individual in that stage during that month.
NOTE: Minimum of six HTTP requests (mouse clicks) to read through all sections of monthly newsletter.

Over the six-month intervention period, there did not appear to be any trends for test subjects accessing dietary information. Heavier access across stages in the first month may be attributed to the novelty of the site. For exercise, when assessing month-to-month access, action stage subjects' access declined through the fourth month

and then increased in the ensuing two months. Preparation and maintenance stages were mixed with no apparent trend. Overall average for diet was highest for preparation (6.9) and maintenance stages (7.6), scoring above the minimum amount of requests for information. Test subjects in the action stage only scored slightly above the minimum amount of HTTP requests to completely review the site (6.0 HTTP requests). Results were the same for exercise behavior. Those at the maintenance stage for exercise were higher in usage than those in action but only demonstrated minimal usage. Generally, more interest was shown in obtaining diet rather than exercise information, as indicated by the increased requests for dietary information over that sought for exercise.

Table 5.2 shows "Average Elapsed Minutes for Monthly Newsletters by Stage, Behavior, and Month." These data report the time spent by a subject in accessing and using the site. The average amount of time needed to review each monthly newsletter is approximately eight minutes, depending on the newsletter content. Dietarily, preparation, action and maintenance stages did not display any consistent trend on a monthly basis. Depending on the month, users either demonstrated heavy use or less than minimal use. The same also appears to be indicated for those using the site for exercise information. As seen with data concerning HTTP requests, subjects spent more time at the site obtaining nutritional information than for exercise.

Table 5.3 summarizes results taken from interactive learning portion of the web site. There is a suggestion that because subjects did well on quizzes throughout each month, they may have read the newsletters. Note that although specific quiz questions referred back to sections within the newsletters, it is possible some of the questions might have been based on common knowledge (i.e., subjects already knew the answer to a question before reading the newsletter content).

Table 5.2. Average Elapsed Minutes for Newsletters by Stage, Behavior and Month.

DIET						
Month	Precontemplative	Contemplative	Preparation	Action	Maintenance	No. of Subjects
1	8	17	10.4	8.5	15.5	20
2	5	0	8	10.4	4.5	17
3	6	0	3	8.9	5.3	17
4	8	0	2.5	3.9	6.0	17
5	5	1	19	8.3	14.8	18
6	12	1	4	5.9	9.8	20
Overall Avg.	**7.3**	**3.2**	**7.8**	**7.7**	**9.3**	
EXERCISE						
Month	Precontemplative	Contemplative	Preparation	Action	Maintenance	No. of Subjects
1	4	NA	9.7	7.5	7.8	20
2	NA	5	4.7	11.3	5.7	17
3	NA	6	8	3.7	4.7	16
4	NA	4	7	4.4	7.0	17
5	NA	11	NA	6.6	7.1	17
6	NA	8	5.3	6.3	10.8	20
Overall Avg.		**6.8**	**6.9**	**6.6**	**7.2**	

n=20
NOTE: NA=no individual in that stage during that month.
NOTE: Minimum of eight minutes to read through all sections of monthly newsletter.

Table 5.3. Percentage of Correct Quiz Answers by Stage and Behavior.

DIET				
Precontemplative	Contemplative	Preparation	Action	Maintenance
93%	91%	96%	93%	97%
EXERCISE				
Precontemplative	Contemplative	Preparation	Action	Maintenance
100%	100%	92%	88%	93%

n=20
NOTE: n<3 for diet and exercise precontemplative and contemplative stages, data not interpreted.

Table 5.4 provides the consolidated results from a short post-intervention questionnaire used to obtain subject opinions regarding the web site. Questions one through four concerned convenience, style, content and delivery of information. In each case, over half of those surveyed agreed positively as to the web site's usefulness characteristics and between 35-45 percent strongly agreed.

Questions five through seven queried whether subjects enjoyed using the web site and derived any benefit from it. Between 35 to 55 percent agreed and interestingly, nearly two-thirds of the subjects strongly agreed they enjoyed getting the information by way of the Internet.

Table 5.4. Exit Survey Results.

QUESTIONS	S. Agree	Agree	Neutral	Disagree	S.Disagree
1. Receiving information by way of the internet was convenient and flexible.	45% (9)	55% (11)	0	0	0
2. Health information by way of the internet was eye-appealing and attention-getting.	35% (7)	55% (11)	10% (2)	0	0
3. Health information by way of the internet was relevant and understandable.	40% (8)	50% (10)	10% (2)	0	0
4. Health information over the internet made me more likely to continue reading my newsletters each month.	35% (7)	60% (12)	5% (1)	0	0
5. Overall, I enjoyed getting my health information over the internet.	65% (13)	35% (7)	0	0	0
6. Do you feel this program helped improve your dietary habits?	40% (8)	50% (10)	10% (2)	0	0
7. Do you feel this program helped improve your physical activity habits?	30% (6)	55% (11)	10% (2)	5% (1)	0
8. Would you recommend this type of program for others in the USAF?	70% (14)	30% (6)	0	0	0

n=20

Question eight posed the issue whether subjects would actually recommend this web site for others. An overwhelming number (70 percent) strongly agreed that they would. Highly positive remarks (all data not shown) provided in the written comments portion of the exit survey appears to substantiate participant affirmation for web site use:

> "Program was useful especially for dietary issues. I became much more aware of my bad eating habits. I've have actively worked to improve my eating habits and make an effort to have 5 servings of fruits and vegetables a day. With care, it proved fairly easy to accomplish."

"Use of the website increased my awareness level. For me, because I truly wanted a lifestyle change, my motivation to change was increased. So, did the web site help me? Yes, because with things like this, I need something "in my face" to keep me focused. Will it help others? Yes, especially for people like me that needs a little shove in the right direction and needs flexibility in their busy schedule. Put this one into use definitely."

"This new interactive approach to health and wellness is an awesome tool to get people involved in taking control of their own fitness. Every aspect of health and fitness was addressed and the links were very helpful. At this time, I can't think of anything I would change."

Other written comments provided additional specifics on web site content. For example, each newsletter had between eight to ten ancillary links to get more authoritative facts on that particular monthly topic. Some felt there were too many to look at:

"I was a bit overwhelmed by all the web sites, maybe have fewer sites available?"

"Possibly shorten the amount of extra links--too many to look at!"

"Plenty of extra web links to see, maybe too many??"

Further suggestion for refinements included placing an automatic e-mail reminder system to help prompt users to continue reading messages on a timely basis. Although the web program had an administrator site where the investigator could monitor subject monthly progress, a message had to be sent manually to the late reader. A far more effective and timesaving device for the administrator of the site would be an automatic messaging system which detects the late reader and sends out a generic reminder message:

> "It may be cumbersome, but I think I might have been late on one of these surveys. I know I did receive some reminder e-mails early on in the research, but I realized that I might have missed the whole month of March as I was on temporary duty (TDY) every other week. If an automatic e-mail could be sent if the survey was not conducted by the 25th of each month, it would probably help as a reminder. I don't know how practical that is though."

Specific comments noted for future improvements include: 1) limit additional web links to view, 2) place an interactive log on the site for individual tracking of diet and exercise progress, 3) automatic messaging system using e-mails as reminders to complete each newsletter.

Discussion

The Internet is an available medium to use in evaluating the efficacy and applicability of a computer-aided, web-based intervention. In this setting, the Internet was used to disseminate health information as well as to closely monitor individual usage of a web-based program as participants progressed through a six-month study. A theory-based behavior change model was incorporated within the design and development of the intervention in order to facilitate change in both diet and exercise habits.

Results indicate that subjects did access the web site for certain amounts of time, depending on the type of behavior (diet or exercise) and stage of readiness to change. Subjects accessed and spent more time viewing nutritional information than reading facts about exercise. Because of the high emphasis placed on fitness within the military, few individuals categorized themselves in the precontemplation and contemplation stages. More subjects reported themselves to be in the advanced stages of readiness for change (already engaging in the new behavior for some time) for exercise, and possibly felt they

did not require more information. Conversely, in the diet category, there were more subjects in the middle stage of preparation (committed to making a change in the next 30 days) and, as a result, needed more information to help modify their dietary behavior. According to Greene (16), guidance is especially critical for both preparation and action stages as they are among the most active stages in the model. These data are useful in planning to assign individuals based on a specific category of health information. For example, an individual may already practice adequate physical activity routines but has found his/her progress stagnated. Seeking to improve his/her exercise regimens, he/she may need more help in correcting or improving marginal dietary habits, which could boost energy levels, thus enhancing stamina.

It is vital to ensure the material is personalized, relevant and understandable for the web site viewer when creating computer-tailored content. The main objective of any behavior change intervention is to evoke changes or, at the very least, have individuals seriously consider them. Using specific materials tailored to an individual's need for change should increase their attention, as well as enhance the likelihood for material to be read and acted upon (20). On average, for both categories, subjects spent the minimum amount of time required to view a monthly newsletter. Some months it was apparent that participants accessed and spent more time than others for both diet and exercise. In Table 5.2, for the stage "Preparation," in month five, an average of 19 minutes was logged for the content of the diet newsletter. Yet for the same stage and behavior in the following month, only four minutes were recorded. In some fashion, the content in the fifth month seems to have attracted more utilization time than was observed for the sixth

month. These data become critical in determining what content to keep and which to revise for future interventions.

A review by Skinner and colleagues (31) reported tailored materials are better retained and reviewed because of their perception as credible, personalized communications. Further, the authors reported tailored information was more effective than non-tailored information in eliciting behavior change based on evidence from numerous studies. Retention is a key aspect of an intervention's efficacy (20), and to increase retention, the program has to hold interest and applicability for the "at-risk" population. In this study, over 90 percent of the subject participants completed the study, with significant results in certain parameters such as weight loss, percent body fat reduction, and lowered blood pressure readings (33).

Measuring the subject understanding of the newsletter content was accomplished using short quizzes which varied in length from three to five questions depending on the subject matter. The purpose of this learning portion was twofold: to aid investigators in facilitating change through reinforcing newsletter content and to use it as an indicator of subject readership. According to proponents of the Transtheoretical Model, an important feature for change is to provide an opportunity to practice what has been learned about the new behavior, especially for those in the act of changing (28). While not accomplished physically, subjects are able to cognitively apply what they have read, gain confidence and subsequently engage in their new behavior. One of the limitations of this study was verifying actual reading time of newsletter content. While the Internet could track access and time of usage, it is unknown whether subjects physically viewed the web site or not.

However, as a partial validation for readership, questions were developed that could only be answered correctly if subjects read through the main content. Using a database manager to ensure each subject answered all questions for each month, high percentages of correct scores were used as an indicator of readership, albeit for only a portion of the time. From Table 5.3 reported results, the preparation, action and maintenance stages for both categories were high, with percentages near or above 90 percent. A large portion of this effect can be attributed to the fact that subjects were allowed to revisit the main message content to re-read material they were unsure of answering in the quiz portion. Again, this was an integral part of "reinforcing" the main message within the newsletter and aiding the reader in gaining confidence regarding the new behavior. Interestingly, although not a great difference, a higher percentage of correct responses were seen for the diet behavior versus that seen with exercise. While there did not appear to be any particular reason for this disparity, it is plausible that because of the greater demand for fitness in the military, subjects may have felt they were more knowledgeable about exercise information and, as a result, did not re-check their responses or had more pre-conceived information which could have led them astray. Further, more subjects were in the intermediate stage of preparation for diet than for exercise. These individuals may have found the information more relevant and personalized for their needs and, as such, retained the information at a greater level in order to score better on their learning portion. Possibly the exercise information could have been treated as "general education information" and was not as well recalled as the perceived "tailored information" in the dietary portions of the monthly newsletters (7, 8).

An important aspect of evaluating a program is soliciting feedback from the targeted at-risk population. While the materials were developed and pre-tested based on guidelines for developing printed materials in health promotion (15, 23, 24, 30), it is equally vital to determine their efficacy and applicability for the entire intervention group at post-study. Because the web site was an experimental prototype for the particular audience targeted (military), questions were developed which queried eight specific domains of interest, using a five-point Likert scale. These domains included: 1) delivery method, 2) format/style appeal, 3) relevancy/comprehension of content, 4) likelihood of usage, 5) overall appeal of the web site, 6) improved dietary habits as a result of the web site, 7) improved exercise habits as a result of the web site, and 8) recommendation for future use.

As a result of focus group findings and because the USAF is one of the more technologically driven services, computers (as well as the Internet) were selected as a delivery vehicle for the intervention. This was borne out by the high percentage of "agree" and "strongly agree" replies provided by survey question one. Style, format and content also received high percentages for agreement and strong agreement, although a few indicated a neutral response, not impressed one way or the other. Getting their information by the web was important for the majority to continue in the program (questions four and five). This can probably be attributed to the fact that the subjects appreciated the convenience, flexibility, and relevancy of the information they received as reflected in questions one through three. Scores were somewhat mixed for questions six and seven, which addressed how well the web site improved specific habits. Subjects felt the dietary aspect of the program was more valuable in getting them to change than

did the exercise portion (40 percent vs. 30 percent strongly agree). One individual reported the site did not help at all with his exercise routines (5 percent). The lower numbers seen in the exercise portion could possibly be the result of larger numbers of subjects had surveyed for the maintenance stage, where individuals have been engaging in the positive behavior for some time. The information provided for that stage may not have been of any practical use, and as such, resulted in the lower percentages.

Question eight responses were overwhelmingly in favor of implementing the web site for others. In fact, 70 percent "strongly agreed" and 30 percent "agreed" that a site of this type should be passed on for USAF personnel to use in positively impacting their health behaviors. The additional written remarks were useful in making refinements for web site future use. Because of the importance to match health information to individual need, receiving target audience input is essential (pre- and post-intervention). Placing an interactive progress log on the site, using an automated e-mail reminder system, and reducing the amount of extra links were all noted as important considerations for web site revision. A last idea (not specifically mentioned by the test subjects) of possible merit is placing a chat room section on the web site. Test subjects could use this part of the web site to share behavior change experiences with each other and more importantly, provide social support for change. Prochaska cites social support as an integral strategy for behavior change, especially for those in the middle to latter stages (preparation, action and maintenance) (28).

Although the Internet can be useful in the evaluation of computer-tailored programs, there were limitations to these data. The sample for which this study was based on was small (n=20), self-selected, and was exclusively military, thus

generalizability is low. While individuals can be tracked on the Internet when using a web-based program, it is difficult to verify whether individuals are actually reading the material. In this study, access, time using the site, learning scores, self-report and physiological parameters were used to measure the effects of using the site; however, content viewing was not verified. The "quizzes" and exit survey did not undergo validity and reliability testing prior to implementation. Because the web site was a prototype developed for experimental purposes, the information acquired was used to make additional modifications for subsequent final implementation.

In summary, use of the Internet offers a unique method to evaluate the efficacy of computer-driven health promotion applications. Its most practical use will depend on the type of individual and the nature of the behavior, as determined by the health care provider. Recommendations for future investigation concerning this style of intervention include use for other health behaviors, utility among other age groups, ethnicities, gender and most importantly, those with varying computer/internet skills and access. These findings may be of relevance to health care providers who work with large numbers of individuals in various settings that precludes them from providing individualized counseling. These health professionals can use the Internet to provide interactive, tailored information, monitor their clientele use for compliance and get their feedback to improve existing programs or initiate new ones. While not necessarily a tool that can be used in all situations, it does present another option for health professionals with limited time and resources to reach and monitor high-risk audiences.

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CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

In the United States, there is a well documented and growing need to effect behavioral changes leading to improved nutritional awareness and more physical activity (6, 8). Worksite health promotion programs show considerable potential for meeting this need (6, 8). In the military, more emphasis is being placed on preventive care and wellness to enhance fitness and military readiness. The USAF medical community has called for the development of worksite programs to help Air Force personnel make the appropriate dietary and exercise behavior choices and embrace them as life-long practices (4). The intervention type and strategy reported here was an experimental program that attempted to facilitate these goals by using Prochaska's Transtheoretical Model (TTM) in an Internet application. While not completely successful in making significant changes in fitness levels, the intervention did produce some positive physiological and behavioral changes in individuals—important changes that persons can use toward making long-term commitments for a healthier lifestyle, both while on active duty and after retirement.

An Internet disseminated health promotion program, this intervention used stage matched diet and exercise information based on the TTM to facilitate positive behavior

change in enlisted Air Force personnel. Stage-matched information was presented in newsletter format on a monthly basis. The main goal throughout the six-month period of behavior modification was to increase daily fruit and vegetable intake and increase the frequency of physical activity in test subjects as a means of improving fitness. More specifically, each monthly newsletter explained in detail topics derived from previous focus group research. Specific topics included the following:

Diet

1. The need for fruits and vegetables in the diet
2. The types of fat in the diet and how to manage them
3. The need for fiber in the diet
4. The way to read nutrition food labels
5. The best methods for understanding nutrition research studies
6. The misconceptions about dietary supplements

Physical Activity

1. The risks of inactivity
2. The myths surrounding exercise and how to debunk them
3. The USAF bike test as a method of assessing your fitness
4. The need for goal-setting
5. The metabolism of fat during exercise
6. The avoidance of injury during exercise

While these data were used in developing the newsletters, some content was not successful in bringing about all the anticipated outcomes as a result of the intervention.

Commensurate with the findings reported in the study, the ensuing discussion concerns recommended changes for the written newsletter content for future application of this type of health promotion program.

Nutritionally, newsletters for increasing fruits, vegetables and fiber in the diet appeared to be of interest to the test subjects. According to the results from the web monitoring of Hyper Text Transfer Protocol requests (mouse clicks or hits to the site of interest) and time spent at the site (from Tables 5.1, 5.2), subjects at all stages used the newsletters in the first month. Test subjects in the preparation and maintenance stages spent more time reviewing the information than did those in the action stage. Newsletter information for these stages concentrated on giving test subjects new ideas for increasing their daily fruit and vegetable intake. This information was of more value to early changers (preparation) who wanted some unique ways to increase consumption. Those in maintenance may have been interested in gaining some variety towards a habit practiced for a long period of time.

The newsletter topic area for fat received more attention from test subjects in action, followed closely by those in preparation stage. Maintenance stage test subjects spent little time viewing this material as compared to the other stages. Subject matter covered in this newsletter gave information on sources of hidden fat in the diet and how to calculate daily fat intake. Using intervention results (chapter four) as a comparison, test subjects using the web site program did significantly lower their fat percent as calories as opposed to controls which increased at post-study. The material devoted to creating awareness concerning overall percent of fat in the diet and ways to lower it seemed to help treatment group subjects as evidenced by improvements in

anthropometric and blood lipid outcomes (chapter four). However, no significant group differences were noted for changing individual fat types in the diet (monounsaturated, polyunsaturated and saturated fats). When evaluated for percent of calories, the treatment group approximated guidelines (3, 7) for the individual fat types. However, the monthly newsletter for describing and managing fat types may not have been facilitative for changes in the right areas. One message may not have been sufficient and further, the material may need to be presented in a more actionable fashion (give examples of foods with low, moderate and high levels of monounsaturated and polyunsaturated fats).

The fiber newsletter along with continual reminders to eat more fruits and vegetables may have aided the treatment group, especially those in the action stage to increase their self-reported daily fiber intakes. Learning to increase fiber in the diet with fruits/vegetables seemed important as a benefit to subjects in that particular stage. Choosing to consume more nutrient dense foods rather than high caloric ones could explain the larger decreases in treatment group dietary cholesterol and blood cholesterol parameters by consuming more plant-based foods and whole grain products to increase fiber levels. This may also account for the small change in daily caloric intake seen with web users. A possible trade-off may have occurred between a fairly high increase in plant-based foods and a small decrease in high-energy type products such as red meat. Calories were higher in the treatment group possibly due to the additional complex carbohydrates (whole grains, fruits and vegetables) they consumed.

Understanding food labels in the fourth monthly newsletter may have had impact for raising awareness of fat in the diet. Although used minimally by treatment subjects in preparation, action and maintenance stage subjects, they may have made better-informed

choices for their diet. Interestingly, maintenance stage subjects spent more time at this newsletter than was indicated by preparation and action subjects. This group may have made better use of this information because of their greater interest in maintaining positive dietary habits and avoiding relapse.

Earlier focus group research (chapter three) revealed considerable test subject frustration with research studies that contradicted current health recommendations. Specifically mentioned were recent controlled intervention trials that involved studying effects of high fiber, fruit and vegetable intakes on preventing recurrence of colorectal polyps (6, 13, 14). The fifth dietary newsletter was devoted entirely to helping subjects make sense of research studies covered by the media. Preparation treatment subjects spent nearly twice as much time viewing this material as opposed to all other monthly newsletters. Maintenance stage subjects also spent more than minimum time reviewing this information, followed by those in the action stage. This information appeared to be of value to all stages and evidently persuaded subjects not to give up on fruits and vegetables for health promotion reasons. This was borne out by the self-report results from the dietary questionnaire which revealed treatment group subjects, on average, were eating the recommended five servings a day of fruits and vegetables (chapter four).

Dietary supplement was another topic of interest requested by the test subjects and was incorporated in the final month. Subjects in the maintenance stage had the highest viewing time as compared to preparation and action stages. The main message asked subjects to seriously consider whether supplements are necessary when eating a balanced diet that includes five servings of fruits and vegetables a day. More

maintenance stage subjects may have been interested in this topic because of their keen interest in health and the desire to find ways to enhance it.

In terms of the physical activity written content, the data suggest these newsletters were not as effective as the dietary newsletters and had limited behavioral impact. Based upon the findings earlier reported (chapter four), it appears the physical activity newsletter content insufficiently motivated treatment subjects to engage in more vigorous exercise to improve fitness levels. As with the dietary newsletters, the main message throughout the six-month intervention was to increase physical activity; however, other topics of interest from the focus group research were also covered.

Among the topics discussed for physical activity (risks of inactivity, debunking myths, bike test, goal-setting, etc.), some apparently facilitated behavior toward a more overall active lifestyle beyond exercise routines. In the first month, newsletter content covered risks of inactivity and appeared to generate interest among all treatment subjects. Preparation stage subjects spent the most time at this monthly newsletter which used a personal testimonial from a peer suffering a heart attack from poor physical activity habits. A key part of that first month's newsletter, a first-hand account of a sedentary lifestyle, may have stimulated advancement for this group. This newsletter also devoted material on how to incorporate more daily physical activity with family recreational outings, sport competitions with friends, new hobbies, etc. Anecdotally, at post-study, many subjects remarked how they spent more time with family and friends doing sports and recreational events during the week and weekends. In this same newsletter, benefits for increasing physical activity were discussed, such as improving one's physical appearance. This was an important point for treatment group subjects at post-study as

some remarked how much better their clothes fit (along with favorable comments by their spouses/friends).

Treatment subjects in action stage spent more time at the monthly newsletter for debunking exercise myths than was observed with others. Perhaps this information was of value for reinforcing material they knew but found important in sustaining their current new behavior. The third monthly newsletter concerning the USAF bike test did not appear to attract much interest for those in the action and maintenance stages. Although derived from the focus group research, this information was obviously not of value to advanced-staged exercisers who may already have a good working knowledge of such information. This was confirmed by the results from post-study HDL levels which did not indicate any measured increases for more intense type of exercise. Although both groups had HDL levels far in excess of current risk factor guidelines (<40 mg/dl) as established by the National Cholesterol Education Program, Adult Treatment Panel III, (5) treatment group HDL levels dropped at post-study rather than increasing as anticipated. Because fitness improvement was a major endpoint for this study, these results highlight a deficiency in the current physical activity newsletters. Additional investigation will be required in developing appropriate information to spur more intense activities. It is interesting to note, however, that treatment subjects in preparation stage did spend more time relative to the other stages viewing this material. The information may have had value in addressing cycle ergometry testing procedures that initial exercisers in the preparation stage may not have been familiar with.

The goal-setting newsletter did appear to have value with preparation and maintenance web users, spending nearly twice as much time at the site as action subjects.

The material for individuals in the maintenance stage concentrated on regular exercisers periodically re-evaluating their goals and striving to challenge themselves to preclude fitness "ceiling effects" or "burnouts." Action and preparation stage newsletters received more emphasis on establishing realistic goals and the need to see incremental progress. As was the case mentioned in the dietary fat newsletter, more actionable-type information may be required (give examples of realistic goals and what changes can be expected) for these stages. An even better idea (suggested by the treatment group) may be to place an interactive goal setting section on the site where subjects can self-monitor their progress.

The fifth monthly newsletter explained differences in fat metabolism at varying levels of exercise intensity. Earlier focus group research revealed individual misconceptions about the amount of fat burned in moderate intensity exercise. Treatment subjects in both action and maintenance stages spent slightly below the minimum amount of time viewing the material (no subject staged for preparation for that month and newsletter). As was the case with the other physical activity newsletter content, this information did not appear to be of value towards inducing higher levels of intense exercise activity. Although percent body fat did change significantly in the treatment group, this difference was more attributed to weight loss from dietary effects as opposed to increased activity.

The last monthly newsletter dealt with methods of avoiding injury during exercise. Focus group data uncovered misperceptions that higher intensity exercise always results in greater risk of injury. This final newsletter attempted to convince subjects injuries can be avoided with proper warm up techniques and gradual training methods. Maintenance stage subjects where much more interested in this topic as

compared to those in action and preparation stages. It may be that these advanced exercisers wanted to make sure they were following the proper guidelines for current training regimens and to avoid relapse as a result of a debilitating injury.

Overall, nutritional message effectiveness seemed appropriate given the results of certain physiological and behavioral outcomes and the self-report intentions to progress one or more stages for diet (chapter four). Conversely, the stage-matched information presented in the physical activity newsletters was not sufficient to prompt increased activity requisite for improved VO_2 levels. The data suggest that, while the intervention may have had an effect in promoting recreational activity, the program was not effective for improving fitness as evidenced by the ergometry results and blood lipid profiles. Self-reported stage movement for physical activity also occurred to a lesser degree in the treatment group as little more than one-third moved on to advanced stages. Lack of success may be due to the initial high numbers of treatment subjects in the action and maintenance stages. Because of this higher number of subjects already engaged in periodic exercise, the newsletters may not have attended to issues requisite for increased exercise levels to achieve greater fitness. Self-reported activity did rise from baseline in web site users, but this activity may have been of a recreational type as opposed to more rigorous intense exercise. Action and maintenance stage newsletters were developed, but the content may not have been of value in addressing concerns, which could have encouraged higher activity levels or provided actionable alternatives to current routines.

In light of the aforementioned findings, the following recommendations are provided for future newsletters:

1) Provide more actionable information in the newsletter for types of fat in the diet.

2) List clear examples of sources of polyunsaturated, monounsaturated and saturated fat in the diet and mention a variety of ways to change the levels of these different fats in meal preparation.

3) Revise content for physical activity newsletters by conducting additional focus group research.

4) Concentrate on obtaining data from specific segments of the target population according to fitness levels determined by current USAF standards. A possible suggestion would be three groups comprised of well-trained (VO_2 score of 40 mil/min/kg or higher), moderately-trained (35-39 mil/min/kg) and less-trained (34 mil/min/kg and below) subjects.

The exit survey used to assess usefulness from the study sample was highly informative. Responses to the exit survey provided at the conclusion of the study indicated very strong and positive subject opinions for web site effectiveness. Most agreed that getting health information via the Internet was convenient and flexible. This was a key finding from earlier focus group research (chapter three) where participants

emphasized the need for having access to information when they wanted it. Almost two-thirds agreed that receiving their information over the web encouraged them to view the materials. An important aspect of the study was that subjects would actually log on and engage the material on a recurring basis. This was verified by the web administrator site, which tracked monthly usage by subject for the entire study. Although some subjects needed periodic reminders to read current newsletters, it did not occur often. The majority complied with web protocol to read all newsletters. However, three subjects did fail to read some diet and exercise newsletters.

When asked if getting the information aided in improving their health habits, 40 percent strongly agreed it helped their dietary habits while only 30 percent did so for physical activity behaviors. This corroborates findings observed for stage progression and improvements in the physiological and self report parameters for this study (chapter four). Web site material for changing nutritional practices appeared to be more effective than that seen for physical activity. Although subjects perceived differences in web site effectiveness for the respective behaviors, an overwhelming majority strongly agreed the site should be implemented for others in the USAF. Exit survey written comments pointed out that, while this program may not be for everyone, it has value for increasing awareness, focus and control of one's health habits.

It is important to emphasize that this study was a low intensity experimental prototype based on a behavior change model. As such, it was not created to induce dramatic or overnight differences but rather gradual, long-term changes towards positive health habits. Many shorter and more intensive programs may elicit greater improvements, but these results generally do not persist over time, nor do they maximize

retention (9). In spite of the equivocal results for the fitness levels, study findings have several practical and medical implications.

First, the web site program offers convenience and flexibility to users. Because the program is placed on the web, individuals can access the information any time at home or at work. This is particularly relevant for Air Force populations where considerable shift work is in place to meet military operational needs. Nearly all Air Force personnel use a computer in their duties or have access to one. With web access, individuals can better manage their time to review their health information, as needed, during a critical moment in the behavior change process. In other words, increase the opportunities for "teachable moments" (9).

Second, it can help extend USAF health professional resources by providing tailored information specific to an at-risk person's needs. Individual counseling, while usually effective, is labor intensive and time consuming. Classes can reach more people, but may present materials suitable for only part of the audience. At the discretion of the health care provider after some initial counseling, this tailored approach helps an individual continue through a comprehensive program. With the web monitoring capability, the health care provider can quickly track the progress of the at-risk person and periodically provide additional feedback as required. It essentially frees up the dietitian or exercise physiologist to work with others who may not be suited for this type of intervention.

Third, the program helps to extend reach for health promotion efforts for a highly itinerant population. Recent downsizing within the military, coupled with rising commitments for humanitarian and peacekeeping missions, have resulted in more

personnel rotations than in the past. To illustrate, an individual has just recently enrolled in a program that may take weeks or months to complete. Suddenly he or she is advised they are being moved to a new location, either in the U.S. or overseas. Because of the uniqueness of the web program's accessibility, health promotion efforts can be sustained in spite of relocation. All the individual needs is a computer with web access, log on and continue with the program at their convenience.

Fourth, a tailored program such as this can certainly help improve overall heath by increasing awareness in other behaviors besides diet and physical activity. USAF personnel may exceed current national health objectives in many categories, but there are negative behaviors such as tobacco use that has cost the USAF millions of dollars in medical care and lost productivity (2). Binge drinking (average of five or more drinks at a time at least once a week) was also reported by 26 percent of those polled by USAF survey which measured prevalence of behavioral risk factors and preventive health practices (1). Nigg and colleagues (10) posit that "gateway behaviors" may exist, that is behaviors when intervened upon, could have positive effects on other behaviors. As people age into their middle years, they become more cognizant of their health and the behaviors associated with maintaining that health (11). During this part of their lives, their receptiveness for multiple behavior change could rise.

Finally, while providing direct benefits in reduced medical expenses and resources associated with chronic disease in active duty populations, this intervention has positive spin-offs for families of those enrolled in the web site program. Not only does the web site encourage the support and involvement of the family in facilitating behavior change, but the family derives the benefit of the knowledge as well. Some subjects

related anecdotes regarding family members enjoying and implementing information obtained from the web site. As subjects went about changing their behavior, individual family members were enacting changes in their diet and physical activity practices as well.

In conclusion, this controlled study of a web-based health promotion intervention to improve diet and physical activity habits has demonstrated that using the TTM to tailor information can facilitate behavior change, albeit at mid stage or higher. Regrettably, the major outcome of the study to advance fitness levels in the sample was not achieved. Obvious limitations included small sample size, FFQ under reporting and inequitable distribution of stage categories. Recommendations for further study, as a minimum, are obtaining much larger samples by recruiting at multiple installations. Closer investigation is merited in other populations such as younger persons, different ranks or women. These groups also represent substantial portions of the USAF. Those entered into conventional weight and fitness improvement programs should also be considered. It would be intriguing to study whether a greater degree of change would occur because of their motivation to meet standards, or in contrast, observe little effect due to minimal contact with staff.

Further testing of Block's FFQ in the Air Force population is advised. Under-reporting hampered comparisons between behavioral and physiological data. No trends were observed with regards to demographics, and subjects did not mention any perceived shortcomings such as missing foods, confusing directions, inordinate length or disorganized format. It is speculative at this point with such a small sample to suggest

the instrument is unsuitable for Air Force populations; however, pilot testing with larger numbers may provide better insight.

Additional investigation for web site efficacy in lower staged samples is clearly warranted. There was insufficient numbers in precontemplation and contemplation for diet and exercise to really make any suggestions for web effects. Efforts need to be undertaken to persuade "yo-yo" dieters and "part-time" exercisers (i.e., starving before weigh-ins and only working out prior to fitness testing) to embrace full-time, life long healthful habits. Additionally, as seen previously with the sub sample of those who initially failed their fitness testing, some modest effect was observed in those exposed to the web site. These may be the best type of individuals within the USAF suited for tailored information. They are probably more motivated to quickly engage in new positive behaviors to meet fitness standards and very likely in need of the carefully constructed cognitive materials provided within the preparation stage (enhance self efficacy, helping relationships, self-liberation, etc.) Finally, it would be of value to see if current effects from the program persist one year later. The emphasis of TTM is to encourage change through a series of stages, forward and backward, until the individual enters maintenance. Was the six-month period sufficient to induce permanent health practices? Asked another way, is there an optimum length of time to promote long-term change and does it depend on the type of behavior? A lengthier investigation of possibly a year with subsequent follow up would help address this question. In any event, more research using the TTM under a wide range of applications, especially technological ones, can only further the health and military readiness of the United States Air Force.

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APPENDIX A

DIET AND PHYSICAL ACTIVITY STAGING ALGORITHMS

DIET ALGORITHM

Various nutrition and health organizations (both private and government) have recommended eating at least 5 servings a day of both fruit and vegetables for good health. Thinking about what your current diet consists of, go through each of the following questions, one at a time, starting with the first one until you come to a question in which your answer is "True". Select the response for the question and click the **Submit** button.

- ○ I do not currently consume 5 servings of fruits and vegetables (combined) per day and I do not intend to do so in the next six months.
- ○ I do not currently consume 5 servings of fruits and vegetables (combined) per day but I am thinking about starting in the next six months.
- ○ I do not currently consume 5 servings of fruits and vegetables (combined) per day but intend to start in the next 30 days.
- ○ I currently consume 5 servings of fruits and vegetables (combined) per day and have done so for a period of less than six months.
- ○ I currently consume 5 servings of fruits and vegetables (combined) per day and have done so for a period of six months or longer.

PHYSICAL ACTIVITY ALGORITHM

Exercise includes moderately intense, continuous activities such as brisk walking, aerobics classes, basketball, jogging, running, swimming, biking, rowing, raquetball etc., or involves the use of spinning, stairmaster, elliptical or treadmill equipment for a period of 30 minutes or longer. Activity exertion levels should reflect a greater increase in your heart rate (within the target range for your age) and cause sweating. Activities that are primarily sedentary such as bowling or golfing with a cart would not be considered exercise. **REGULAR EXERCISE = 3 TIMES OR MORE PER WEEK**.

Thinking about whether you engage in regular exercise **according to the above definition**, go through each of the following questions, one at a time, starting with the first one until you come to a question in which your answer is "True". Select that response for that question and click the **Submit** button.

- ○ I do not currently exercise on a regular basis and I do not intend to start exercising regularly in the next six months.
- ○ I do not currently exercise on a regular basis but I am thinking about starting to exercise regularly in the next six months.
- ○ I do not currently exercise on a regular basis but intend to start in the next 30 days.
- ○ I currently exercise regularly but have only begun doing so within the last six months.
- ○ I currently exercise regularly and have done so for more than six months.

APPENDIX B

HUMAN RESEARCH APPROVAL AND CONSENT FORMS FOR FOCUS GROUP RESEARCH

Colorado State University

Office of Regulatory Compliance
Office of Vice President for Research
and Information Technology
Fort Collins, CO 80523-2046
(970) 491-1563
FAX: (970) 491-2293

JUL 28 1999

MEMORANDUM

TO: Jennifer Anderson, Food Science and Human Nutrition, 1571

FROM: Celia S. Walker, Administrator
Human Research Committee

SUBJECT: PROJECT APPROVAL
Title: Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel
Protocol No.: 99-081H
Funding Agency: USAF Academy
Funding Agency Deadline: 04/01/99

DATE: July 26, 1999

I am pleased to inform you that the above-referenced project was approved by the Human Research Committee on July 15, 1999 for the period July 15, 1999 through July 15, 2000 with the condition that the attached consent form is signed by the subjects and each subject is given a copy of the form. It is the investigator's responsibility to obtain this consent form from all subjects. *NO changes may be made to this document without first obtaining the approval of the Committee.*

A status report of this project will be required within a 12-month period from the date of approval. The necessary form (H-101) will be mailed to you prior to that date and is available on the Human Research Committee web page.

It is the responsibility of the investigator to immediately inform the Committee of any serious complications, unexpected risks or injuries resulting from this research.

It is also the investigator's responsibility to notify the Committee of any changes in experimental design or consent procedures (file Form H-101).

This approval is issued under Colorado State University's OPRR Multiple Projects Assurance M-1153-01 issued August 1, 1996.

Please direct any questions about the Committee's action on this project to me for routing to the Committee.

Attachment

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS UNITED STATES AIR FORCE ACADEMY
USAF ACADEMY, COLORADO

From: Miller, James
Sent: Wednesday, July 07, 1999 4:58 PM
To: Don Veverka
Cc: Batt, Mona; Odonnell, Kathy
Subject: expedited review

Maj Veverka,

Your protocol, "Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel," was reviewed by two members of the USAFA IRB. The protocol was viewed as minimal risk. The only comment was that the statement in the Purpose section of the ICD, "Additionally, by signing this consent form, I will be considered a potential participant for subsequent research at Peterson that will study an alternative nutrition and exercise intervention." may be misconstrued. I suggest that you replace the word "considered" with the phrase "contacted as."

As a result of this expedited review, you may initiate your study in accord with the protocol. The full IRB will review the proposal at its July meeting. You will be contacted with the results of that review.

Dr. Miller for [signature], Human Use Chair

James C. Miller, Ph.D., CPE
Director, Human-Environmental Research Center
and Chair, USAFA IRB
2354 Fairchild Hall, Ste. 4K27, DFE
USAF Academy, CO 80840
719-333-2804 (fax -4255) (DSN 333-2804)
http://www.usafa.af.mil/dfe/herc

Colorado State University
Informed Consent to Participate in a Research Project

TITLE OF PROJECT: Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel

NAME OF PRINCIPAL INVESTIGATOR: Jennifer Anderson, Ph.D., RD, Professor and Extension Specialist

NAME OF CO-INVESTIGATOR: Don Veverka, MS, Assistant Professor

CONTACT NAME AND PHONE NUMBER FOR QUESTIONS OR PROBLEMS: Don Veverka 491-7225

SPONSOR OF PROJECT: United States Air Force Academy

PURPOSE OF THE RESEARCH: The purpose of the research is to determine the factors that will contribute to participating in a healthy lifestyle program. Specifically, looking at those factors surrounding increasing physical activity and promotion of good eating habits.

PROCEDURES/METHODS TO BE USED: A focus group has an open discussion format to solicit opinions and ideas. Food and beverages will be provided. The sessions will be two hours in length and will be audiotaped to be sure the investigators will not miss any comments or ideas. Audiotapes and any other gathered information will be kept in a secure locked location, identified only by coded numbers and accessible only to the research investigators. In accordance with United States Air Force research policy, this information will be kept secure for a period of three years and then subsequently destroyed.

RISKS INHERENT IN THE PROCEDURE: There are no substantial risks to the individual. It is not possible to identify all potential risks in an experimental procedure, but researchers have taken reasonable safeguards to minimize both the known and the potential, but unknown, risks.

BENEFITS: You will have the opportunity to meet other individuals and hear how they feel about healthy lifestyle programs, physical activity issues, and eating healthy issues. The ultimate goal of the focus groups are to determine factors which allow for instituting a healthy lifestyle in yourself and others and help the USAF plan and conduct successful healthy lifestyle programs.

CONFIDENTIALITY: While confidentiality during group discussions is not possible, only first names will be used during the discussions. The recorded comments as well as the information collected by the paper and pencil survey will be identified with code numbers and not names. Thus while not anonymous, all data will be kept confidential. Only the PI and Co-PI will have access to information linked to individuals.

LIABILITY: The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

Questions about subjects' rights may be directed to Celia S. Walker at (970) 491-1563

PARTICIPATION: Your participation in this research is voluntary. If you decide to participate in this study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which your are otherwise entitled.

Additionally, You may volunteer as a participant for subsequent research at Peterson AFB that will study nutrition and exercise habits. If you wish to be contacted to participate in this later study, please initial here_______.

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing _______ pages.

____
Participant Name (printed)

_______________________________ _______________
Participant signature **Date**

_______________________________ _______________
Co-Investigator or Research Staff signature **Date**

INFORMED CONSENT DOCUMENT

DEPARTMENT OF THE AIR FORCE

USAF ACADEMY, COLORADO, 80840

Privacy Act and Freedom of Information Act

I understand that records of my participation in this study may only be released in accordance with federal law. The Freedom of Information Act, 5 U.S.C. 552, the Federal Privacy Act, 5 U.S.C. 552a, and their implementing regulations may apply.

TITLE OF STUDY

Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel

INVESTIGATORS' NAME(S), DEPARTMENT(S), PHONE NUMBER(S)

Donald Veverka, Colorado State University, (970) 491-7225

PURPOSE OF STUDY

I understand that I am being asked to participate in a research study. The purpose of the study is to gather information concerning nutrition and exercise. The information will be gathered via focus groups of 8-10 individuals and last approximately two hours in length per group. I will be asked to participate in only one group session and understand I will also need to complete a written demographic survey prior to the focus group session. Additionally, by signing this consent form, I may be contacted as a potential participant for subsequent research at Peterson that will study an alternative nutrition and exercise intervention.

PROCEDURES

1. The project was described to me by Donald Veverka, from the Department of Food Science and Human Nutrition, Colorado State University. I have had time and opportunity to ask questions about the project and about being a participant in a focus group, and I have found no more questions at this time.

2. I understand that I will:

   - be interviewed and engage in group discussions with a focus group moderator and researcher
   - be asked to provide some information of a personal nature, as well as my knowledge, in spoken and written form, relevant to topics about nutrition and exercise
   - be able to terminate my participation in the focus group and/or refuse to answer any question(s) at any time without negative action taken against me by the researcher or anyone affiliated with the researcher

3. I understand that:

   - the information I provide will be kept private and that the researcher will do everything possible to maintain the privacy of that information
   - my comments will be audio-taped and recorded for analysis and research purposes and that these tapes and any other gathered information will be kept in a secure locked location accessible only to the research investigator
   - Federal law (Privacy Act) say the researcher is not allowed to associate my full name or social security number with my data, without my expressed permission, in any reports he writes

4. I understand I will NOT receive any financial compensation or any other gift, payment, remuneration, etc for being a participant

5. I understand that the researcher may terminate the focus group session or interview at any time and may not use me as a participant.

6. I understand that questions I think of later about being a focus group participant can be answered by:

Donald V. Veverka
Colorado State University
Department of Food Science and Human Nutrition
Gifford Building
Fort Collins, CO 80523
(970) 491-7225
E-Mail: dveverka@lamar.colostate.edu

BENEFITS

I understand there are no direct benefits to me for my participation in this study.

RISKS/INCONVENIENCES

I understand I must receive permission from my immediate supervisor to attend the focus groups during duty hours and that I must be in civilian attire at the time of participation in the focus group session.

PROCEDURES

7. The project was described to me by Donald Veverka, from the Department of Food Science and Human Nutrition, Colorado State University. I have had time and opportunity to ask questions about the project and about being a participant in a research study, and I have found no more questions at this time.

8. I understand that I will:

- be interviewed by the researcher to determine eligibility criteria
- need access to a computer (if in the treatment group) in which to read various web-based health messages on nutrition and exercise (2 messages per month, six month study for a total of 12 messages read). If in the control group, access to a computer is not necessary as no web-based messages will be provided to this group.
- need to provide written survey information regarding demographic information (age, ethnic background, rank, etc.), dietary patterns and physical activity habits.
- be required to provide the following physical measurements as part of the study:

  l. blood cholesterol levels (from a blood draw sample taken by USAF lab personnel)
  m. height
  n. weight
  o. percent body fat (using current USAF taping methods)
  p. blood pressure
  q. waist-to-hip ratio (using taping methods)
  r. cycle ergometry scores (using current USAF cycle ergometry methods and certified fitness assessment monitors for testing)
  s. resting heart rate (from current USAF cycle ergometry test)

- be able to terminate my participation in the study and/or refuse to answer any question(s) at any time without negative action taken against me by the researcher or anyone affiliated with the researcher

9. I understand that:

- the information I provide will be kept private and that the researcher will do everything possible to maintain the privacy of that information
- the information I provide will be kept and recorded for analysis and research purposes and that this and any other gathered information will be kept in a secure locked location accessible only to the research investigator
- I will continue to maintain USAF weight and fitness standards

10. I understand I will NOT receive any financial compensation or any other gift, payment, remuneration, etc for being a participant.

11. I understand that the researcher may terminate the study or interview at any time and may not use me as a participant.

12. I understand that questions I think of later about being a study group participant can be answered by:

Donald V. Veverka
Colorado State University
Department of Food Science and Human Nutrition
Fort Collins, CO 80523
(719) 548-0834
E-Mail: veverkas@att.net

COMPENSATION FOR TREATMENT OF INJURY

I understand that my entitlement to medical and dental care and/or compensation in the event of injury is governed by federal laws and regulations. If I have questions about my rights or if I believe I have received a research-related injury, I may contact the USAF Academy Institutional Research and Assessment Division (HQ USAFA/XPR) at 719-333-2587.

DECISION TO PARTICIPATE

The decision to participate in this study is completely voluntary on my part. No one has coerced or intimidated me into participating in this program. I understand that if I refuse to participate, I will not lose any benefits that I am entitled to. I am participating because I want to. My investigator has adequately answered any and all questions I have about this study, my participation, and the procedures involved. I understand that an investigator will be available to answer any questions concerning procedures throughout this study. I understand that if significant new findings develop during the course of this study that may relate to my decision to continue participation, I will be informed. I further understand that I may withdraw this consent at any time and discontinue further participation in this study without prejudice to my rights. I also understand that the investigator may terminate my participation in this study at any time if he/she feels this to be in my best interest. I have been provided a copy of this consent form.

QUESTIONS REGARDING MY PARTICIPATION IN THIS RESEARCH STUDY

If I have questions about this research study, I should contact the principal investigator, Don Veverka, at (970) 491-7225. If I have questions about my rights as a research subject, or if I have received a research-related injury, I should contact the USAF Academy Institutional Research and Assessment Division (HQ USAFA/XPR) at 719-333-2587.

My signature below indicates my willingness to participate in this research study.

Subject's printed name	Subject's SSAN
Subject's signature	Date

Advising Investigator's Signature	Advising Investigator's SSAN	Date
Witness' Signature	Witness's SSAN	Date

Distribution: Principal Investigator and Subject.

APPENDIX C

DEMOGRAPHIC QUESTIONNAIRE FOR FOCUS GROUP RESEARCH

This demographic survey is part of the focus group research effort you will be participating in today. It asks your personal knowledge and opinions on issues regarding nutrition and physical activity. Your assistance in completing this survey will help us develop healthy lifestyle programs for men and women in the United States Air Force. Answer the questions to the best extent possible following the instructions given. Do not place your name or SSAN on any part of this survey. Use only the code number you were given prior to receiving this survey. All information will be kept confidential and used only for purposes of research and study.

CODE NUMBER: ________________

Demographics **Date:___________**

1. Age: ________ 35-39
   ________ 40-44

2. Ethnicity:
   Caucasian ________
   Afro-American ________
   Native American ________
   Asian ________
   Hispanic ________

3. Education level completed:
   ________ High school
   ________ Junior college
   ________ College (4 or more years)
   ________ Graduate college (MS, PhD, etc..)

4. Current job: ________________________

5. Are you participating in a structured fitness program (on or off-base) such as strength – training or low impact aerobics?

   ________ yes ________ no

6. Do you work out on a regular basis (at least 3 times per week)?

   ________ yes ________ no

7. Are you currently on the USAF weight management program?

   ________ yes ________ no

8. What is your history in successfully passing the bike test?

   ________ always pass ________ usually pass but struggle at times

   ________ have failed more than once

9. Do you work out just prior to taking the bike test (i.e., within a few months or days of the test) ?

   ________ yes ________ no

10. If the answer in number 9 is yes, how many days in advance of the test do you begin working out? If your answer is no, go to question 11.

    ____________ days

11. Where and how often in a one week period do you eat your meals during duty hours ? For example, if you work from 0730 –1700, you may eat at McDonald's twice a week for breakfast. The other 3 days may be breakfast at home before departing for work. For lunch you usually eat at the enlisted dining facility and maybe skip eating one lunch meal a week.

	Enlisted Dining Facility	Enlisted Club	BX Fast-Food Outlets	Home	Off-Base Restaurants	Skip the meal altogether
Breakfast						
Lunch						
Dinner						

12. How often have you been on a diet? ________ times. Was the diet medically directed and controlled or self-administered with over-the-counter weight reducing aids (e.g., Dexatrim) or commercial supplements (e.g., Slim-Fast)?

Thank you for your assistance in completing this survey!

APPENDIX D

FOCUS GROUP DISCUSSION QUESTIONS

FOCUS GROUP QUESTIONS

1. As we go around the room, please tell us your first name and your favorite activity

2. What are your feelings about maintaining good health?

   Probe: On a scale of 1-10, (with ten the highest, one the lowest) rate your personal feelings on exercise and nutrition importance

   Probe: What importance do you place on exercise and nutrition?

3. What does exercise mean to you?

   Probe: How is exercise different from physical activity?

4. What does nutrition and healthy eating mean to you?

   Probe: How is dieting different from nutrition?

5. Please jot down all the relevant <u>*strengths*</u> (motivators) of increased physical activity.

   Probe: Working together as a team, rank order the strengths you identified with the most important ones at the top.

6. Please jot down all the relevant <u>*negative aspects*</u> (barriers) of increased physical activity.

   Probe: Working together as a team, rank order the negative aspects you identified with the most important ones at the top.

7. Please jot down all the relevant <u>*strengths*</u> (motivators) of good nutrition.

   Probe: Working together as a team, rank order the strengths you identified with the most important ones at the top.

8. Passing this sheet rapidly from one person to the next, please jot down all the relevant <u>*negative aspects*</u> (barriers) of good nutrition.

   Probe: Working together as a team, rank order the negative aspects you identified with the most important ones at the top.

9. "Health warnings about the lack of regular physical activity and poor eating habits worry me." How does this apply to you as an individual?

10. Who influences your efforts to be physically active?

    Probe: Is it family, friends, superiors? How do they influence your efforts?

11. Who influences your efforts when it comes to healthy eating?

    Probe: Is it family, friends, superiors? How do they influence your efforts?

12. Tell me about your physical activity patterns that may have changed.

    Probe: What do you do now or no longer do? What prevented you from continuing the activity?

13. Tell me about your eating patterns that may have changed.

    Probe: What do you do now or no longer do? What prevented you from continuing the activity?

14. What would help you to increase your physical activity?

    Probe: Is it information, learning a skill or an activity?

15. What specific things would you like to know more about when it comes to eating healthy?

16. We are planning a program to assist anyone in the USAF experiencing difficulty in meeting the fitness standard. What part of the dieting and exercise portion of current USAF programs are helpful? What parts are not?

    Probe: What components of a healthy lifestyle program would make you want to participate in?

    Probe: Would a "buddy" or "work-out partner" help or hinder efforts to increase your physical activity and improve your diet? Please explain.

    Probe: Would personalized beginning training and counseling sessions be of any value towards increasing your desire to be physically active and eating well?

    Probe: In what manner would you like to receive information regarding these topics (newsletters, classes, group discussions..........)

17. In closing, what other advice would you like to share?

APPENDIX E

NEWSLETTER MATRIX

Newsletter Matrix – Precontemplation Stage

STAGE	CONTENT AREA	CONSTRUCTS	STRATEGY/CONTENT ELEMENTS	OUTCOME/OBJECTIVE
Precontemplation	"Points to Ponder"	Consciousness-Raising Dramatic Relief Environmental Re-evaluation Self Re-evaluation	Increase awareness of problem behavior using factual information: ✓ Mention risk factors of and consequences of unhealthy lifestyle ✓ Financial impact and burden of disease treatment ✓ National health statistics Use "personalized" thoughtfully constructed questions to get subjects to evaluate their behavior. Allow subjects to consider the need to make change: ✓ Pose as risk to themselves by engaging in unhealthy lifestyle ✓ Pose as other outside risks such as quality of life w/family or jeopardizing career w/ Air Force	Think about the possibility in the next six months or sooner: ✓ Increasing fruit and vegetable daily servings ✓ Increasing daily fiber intake ✓ Decreasing daily total and saturated fat intake ✓ Increasing physical activity levels ✓ Reduce calories
	"Check Your Learning"	Consciousness-Raising	Learning activity to aid subjects in initially grasping factual information ✓ Key in on health statistics ✓ Key in on introducing behavior change methods to reduce risks	
	"Did You Know…"	Consciousness-Raising	Used to help subjects see the significance of behavior change from a larger perspective ✓ Additional health statistics ✓ Results from scientific studies ✓ Resolving myths about diet and exercise	
	"Want to Know More"	Consciousness-Raising Dramatic Relief	An additional opportunity to further enhance subject's understanding of the problem behavior using outside credible and authoritative sources ✓ Professional organizations (AMA, ADA, ACSM, etc…) ✓ Government organizations (NIH, USDA, DHHS, NAS, CDC, etc…) ✓ Trade organizations (Produce for Better Health, National Dairy Council, Wheat Foods Council, etc.) ✓ Others (American Cancer Society, American Heart Assoc, etc.)	

Newsletter Matrix – Contemplation Stage

STAGE	CONTENT AREA	CONSTRUCTS	STRATEGY/CONTENT ELEMENTS	OUTCOME/OBJECTIVE
Contemplation	"Points to Ponder"	Consciousness-Raising Dramatic Relief Environmental Re-evaluation Self-Reevaluation Decisional Balance Self-Efficacy	Increase awareness of problem behavior using factual information: ✓ Mention risk factors of and consequences of unhealthy lifestyle ✓ Financial impact and burden of disease treatment ✓ National health statistics Use "personalized" thoughtfully constructed questions to get subjects to evaluate their behavior. Allow subjects to consider the need to make change: ✓ Pose as risk to themselves by engaging in unhealthy lifestyle ✓ Pose as other outside risks such as quality of life w/family or jeopardizing career w/Air Force List benefits of engaging in new behaviors and drawbacks with old behaviors ✓ Emphasize benefits beyond health (cost, avoiding boredom, ease of preparation, appearance, family time, etc.) ✓ Minimize perceived "cons" associated with new behavior Begin initial attempts to help subjects build confidence in practicing new behavior ✓ Reinforce any changes that subjects may already be achieving ✓ Emphasize making a start and making small changes at first ✓ Encourage subjects to set specific but achievable goals ✓ Continue to resolve barriers to new behavior	Think about the possibility in the next 30 days or sooner: ✓ Increasing fruit and vegetable daily servings ✓ Increasing daily fiber intake ✓ Decreasing daily total and saturated fat intake ✓ Increasing physical activity levels ✓ Reduce calories
	"Check Your Learning"	Consciousness-Raising	Learning activity to aid subjects in initially grasping factual information ✓ Key in on health statistics ✓ Key in on introducing behavior change methods to reduce risks and build self-confidence ✓ Key in on benefits of new behavior	
	"Did You Know…"	Consciousness-Raising Decisional Balance Self-Efficacy	Used to help subjects see the significance of behavior change from a larger perspective ✓ Additional health statistics ✓ Results from scientific studies ✓ Resolving myths about diet and exercise to build confidence ✓ Additional benefits of new behavior	
	"Want to Know More"	Consciousness-Raising Decisional Balance Self-Efficacy	An additional opportunity to further enhance subject's understanding of the problem behavior using outside credible and authoritative sources ✓ Professional organizations (AMA, ADA, ACSM, etc…) ✓ Government organizations (NIH, USDA, DHHS, NAS, CDC, etc…) ✓ Trade organizations (Produce for Better Health, National Dairy Council, Wheat Foods Council, etc.) ✓ Others (American Cancer Society, American Heart Assoc, etc.)	

Newsletter Matrix – Preparation Stage

STAGE	CONTENT AREA	CONSTRUCTS	STRATEGY/CONTENT ELEMENTS	OUTCOME/OBJECTIVE
Preparation	"Points to Ponder"	Helping Relationships Self-liberation Decisional Balance Self-Efficacy	Increase awareness of subjects to seek out social support for healthy behavior change: ✓ Give information/ideas where to seek help ✓ Encourage use of buddy system Emphasize and promote idea that subjects can change and the importance of acting out on that commitment to change ✓ Give positive feedback for making the decision to change ✓ Commend subjects for whatever small changes have been made List benefits of engaging in new behaviors and drawbacks with old behaviors ✓ Emphasize benefits beyond health (cost, avoiding boredom, ease of preparation, appearance, family time, etc.) ✓ Minimize perceived "cons" associated with new behavior Continue helping subjects build confidence in practicing new behavior ✓ Reinforce any changes that subjects may already be achieving ✓ Emphasize making a start and making small changes at first ✓ Encourage subjects to set specific but achievable goals	Actually engaging in the new behavior initially through: ✓ Minimum 5-A-Day fruit and vegetable servings ✓ Increased daily fiber intake ✓ Decreased daily total and saturated fat intake ✓ Increased physical activity levels from exercising 3 or more days per week at 30 minutes or longer per session ✓ Reduce calories
	"Check Your Learning"	Consciousness-Raising	Learning activity to aid subjects in grasping factual information and starting to put it into practice to reinforce change ✓ Key in on levels of change to attempt ✓ Key in on introducing behavior change methods to reduce risks and build self-confidence ✓ Key in on benefits of new behavior	
	"Did You Know…"	Consciousness-Raising Decisional Balance Self-Efficacy	Help subjects gain more information to use in increasing and maintaining successful behavior change ✓ Additional health statistics ✓ Results from scientific studies ✓ Resolving myths about diet and exercise to build confidence ✓ Additional benefits of new behavior	
	"Want to Know More"	Consciousness-Raising Decisional Balance Self-Efficacy	An additional opportunity to further enhance subject's understanding of their new behavior using outside credible and authoritative sources ✓ Professional organizations (AMA, ADA, ACSM, etc…) ✓ Government organizations (NIH, USDA, DHHS, NAS, CDC, etc…) ✓ Trade organizations (Produce for Better Health, National Dairy Council, Wheat Foods Council, etc.) ✓ Others (American Cancer Society, American Heart Assoc, etc.)	

Newsletter Matrix – Action Stage

STAGE	CONTENT AREA	CONSTRUCTS	STRATEGY/CONTENT ELEMENTS	OUTCOME/OBJECTIVE
Action	"Points to Ponder"	Helping Relationships Counter-conditioning Stimulus Control Contingency Management Decisional Balance Self-Efficacy	Increase awareness of subjects to seek out social support for healthy behavior change: ✓ Give information/ideas where to seek help ✓ Encourage use of buddy system Discuss how subjects can use healthy behaviors to substitute for problem behaviors ✓ Use examples from successful changers Discuss how subjects can avoid relapse to problem behaviors by removing cues for unhealthy habits ✓ Use examples from successful changers Describe importance of rewarding self for making desired changes ✓ Remind subjects the importance of rewarding self for healthy behavior change ✓ Facilitate by providing subjects suggestions for rewards List benefits of engaging in new behaviors and drawbacks with old behaviors ✓ Emphasize benefits beyond health (cost, avoiding boredom, ease of preparation, appearance, family time, etc.) ✓ Minimize perceived "cons" associated with new behavior Strengthen subject's confidence in practicing new behavior ✓ Reinforce any changes that subjects are already achieving ✓ Emphasize the need to continue practicing the new behavior ✓ Encourage subjects to set specific but achievable goals	Full and consistent adoption of the new behavior longer than 6 months through: ✓ Minimum 5-A-Day fruit and vegetable servings ✓ Increased daily fiber intake ✓ Decreased daily total and saturated fat intake ✓ Increased physical activity levels from exercising 3 or more days per week at 30 minutes or longer per session ✓ Reduce calories
	"Check Your Learning"	Decisional Balance Self-Efficacy	Learning activity to aid subjects in grasping factual information and putting it into practice to reinforce change ✓ Key in on sustaining the new behavior change ✓ Key in on behavior change methods to reinforce skills of new behavior and sustain self-confidence ✓ Key in on benefits of continuing new behavior	
	"Did You Know…"	Consciousness-Raising Decisional Balance Self-Efficacy	Help subjects gain more information to use in increasing and maintaining successful behavior change ✓ Additional health statistics ✓ Results from scientific studies ✓ Resolving myths about diet and exercise to build confidence ✓ Additional benefits of new behavior	
	"Want to Know More"	Consciousness-Raising Decisional Balance Self-Efficacy	An additional opportunity to further enhance subject's understanding of the problem behavior using outside credible and authoritative sources ✓ Professional organizations (AMA, ADA, ACSM, etc…) ✓ Government organizations (NIH, USDA, DHHS, NAS, CDC, etc…) ✓ Trade organizations (Produce for Better Health, National Dairy Council, Wheat Foods Council, etc.) ✓ Others (American Cancer Society, American Heart Assoc, etc.)	

Newsletter Matrix – Maintenance Stage

STAGE	CONTENT AREA	CONSTRUCTS	STRATEGY/CONTENT ELEMENTS	OUTCOME/OBJECTIVE
Maintenance	"Points to Ponder"	Counter-conditioning Stimulus Control Contingency Management Decisional Balance Self-Efficacy Social Liberation Relapse	Discuss how subjects can use established healthy behaviors to substitute for problem behaviors ✓ Use examples from successful changers Discuss how subjects can avoid relapse to problem behaviors by removing cues for unhealthy habits ✓ Use examples from successful changers Describe importance of rewarding self for making desired changes ✓ Remind subjects the importance of rewarding self for healthy behavior change ✓ Facilitate by providing subjects suggestions for rewards List benefits of engaging in established behaviors and drawbacks with old behaviors ✓ Emphasize benefits beyond health (cost, avoiding boredom, ease of preparation, appearance, family time, etc.) ✓ Remind subjects of the original reasons for changing Strengthen subject's confidence in practicing established behavior ✓ Reinforce and emphasize the need to continue practicing the established behavior ✓ Encourage subjects to set specific but more challenging goals Describe ways to incorporate established behaviors in social settings ✓ Give examples of implementing established behaviors in society ✓ Encourage the use of family and friends to help in most social environments Preparation for and prevention of relapse ✓ Discuss the need to plan ahead for possible lapses in established behavior ✓ Explain that "recycling" to an earlier stage can be a part of the change process ✓ Provide examples to help prevent relapse	Prevention of relapse and consistently engage in the established healthy behavior for an extended period of time (more than six months): ✓ Minimum 5-A-Day fruit and vegetable servings ✓ Increased daily fiber intake ✓ Decreased daily total and saturated fat intake ✓ Increased physical activity levels from exercising 3 or more days per week at 30 minutes or longer per session ✓ Reduce calories
	"Check Your Learning"	Decisional Balance Self-Efficacy	Learning activity to aid subjects in grasping factual information and putting it into practice to reinforce change ✓ Key in on sustaining the established behavior change ✓ Key in on behavior change methods to reinforce skills of established behavior and sustain self-confidence ✓ Key in on benefits of sustaining established behavior	
	"Did You Know…"	Consciousness-Raising Decisional Balance Self-Efficacy	Help subjects gain more information to use in increasing and maintaining successful behavior change ✓ Additional health statistics ✓ Results from scientific studies ✓ Resolving myths about diet and exercise to remove any confusion ✓ Additional benefits of established behavior	
	"Want to Know More"	Consciousness-Raising Decisional Balance Self-Efficacy	An additional opportunity to further enhance subject's understanding of their established behavior using outside credible and authoritative sources ✓ Professional organizations (AMA, ADA, ACSM, etc…) ✓ Government organizations (NIH, USDA, DHHS, NAS, CDC, etc…) ✓ Trade organizations (Produce for Better Health, National Dairy Council, Wheat Foods Council, etc.) ✓ Others (American Cancer Society, American Heart Assoc, etc.)	

APPENDIX F

NEWSLETTER FORMAT EXAMPLE

PRECONTEMPLATIVE MESSAGE – DIET – MONTH 1

"POINTS TO PONDER"

Right now the last thing you want to do is eat fruit and vegetables, but did you know you are putting yourself at risk for ill health? At the moment, you may feel fine without any physical ailments. However, scientific studies show that a balanced diet with at least five servings of fruits and vegetables a day can actually improve your health. What's more, eating five servings of fruit and vegetables a day can ***PREVENT*** you from losing your good health. For example, people who eat 5 or more servings of fruits and vegetables every day have ½ the risk of developing cancer as those who eat only one or two servings per day (http://www2.cancer.org/prevention/index.cfm?prevention=1 American Cancer Society web site) . Right now in the United States, one in every four deaths is due to cancer. About 1.2 million new cancer cases will be diagnosed this year and about half a million will die from cancer—more than 1,500 people a day. Heart disease accounts for 2,600 deaths everyday and more than 30 percent of Americans are considered obese (which leads to even higher risk for other diseases like high blood pressure and diabetes). What is even more worrisome is the cost burden associated with treating people with these ***preventable*** diseases. Heart disease alone is estimated to cost more than $274 billion dollars annually in treatment expenditures and lost productivity. More than $110 billion in total health and related costs is associated with cancer and over 6 percent of U.S. healthcare dollars (60 billion dollars annually) are spent in treating disorders as a result of obesity. You may ask yourself, does any of this apply to me? Review the questions below and take a moment to think about your answers.

- Is there a family history of cancer, heart disease, diabetes, or other chronic illness that I may or may not be aware of that could be putting me at risk?
- Has my doctor warned that I could be vulnerable for a chronic disease at some time in the future (i.e., increasing blood levels of cholesterol)?
- Am I endangering my quality of life with my family and friends in terms of my health by not eating at least five servings of fruits and vegetables a day?

"CHECK YOUR LEARNING"

To help you better understand and review what you have just read, please take this short quiz and press the "submit" button when finished to check your answers. In addition if you would like more information about this topic, there are some supplementary credible web sites you can access. Just click on "want to know more?"

1) What is the minimum amount of servings of fruits and vegetables I need to promote my good health?

   a. 1-2 servings a day
   b. 3-4 servings a week
   c. 5 servings per day
   d. 3-4 servings per day
   e. 5 servings per week

2) High intake of fruits and vegetables appear to be especially protective against diseases like heart disease, obesity and cancer:

   a) True
   b) False

3) My risk of getting some form of cancer is cut in half by eating at least 3 servings of fruit and vegetables every day:

   a) True
   b) False

"DID YOU KNOW...?"

- U.S. diets tend to be high in fat and low in fruits and vegetables. Surveys have shown that only 19 percent of men report eating the recommended 5 servings of fruits and vegetables per day

- In addition to being high in vitamins and minerals, fruits and vegetables are also rich in Phytochemicals (pronounced fight-o-chemicals). These phytochemicals give plants their color and research has suggested that they work together with the vitamins and minerals to help reduce your chances of getting cancer, heart disease and other illnesses.

- Supplements generally do not provide the same level of protection that natural sources of fruits and vegetables do. Supplements may only contain a few of the necessary substances needed to provide protection against disease.

Source: National Cancer Institute

"WANT TO KNOW MORE"

NOTE: The appearance of these hyperlinks does not constitute endorsement by the U.S. Air Force of this Web site or the information, products, or services contained therein. For other than authorized activities such as military exchanges and morale, welfare and recreation sites, the USAF does not exercise any editorial control over the information you may find at these locations. Such links are provided consistent with the stated purpose of this DoD web site.

http://www.usda.gov/cnpp (United States Department of Agriculture, Center for Nutrition Policy and Promotion)

http://www.dccps.nci.nih.gov/5aday (National Institutes of Health, National Cancer Institute)

http://www.eatright.org/ (American Dietetic Association)

http://www.cdc.gov/od/oc/media (Center for Disease Control)

http://www.5aday.com/ (Produce for better health foundation)

http://www.healthfinder.gov/ (U.S. Department of Health and Human Services)

Making the move towards being more active?? Exercise. You only have to take it regularly, not seriously!

Make the Start → for your body and heart!!!

APPENDIX G

HUMAN RESEARCH APPROVAL AND CONSENT FORMS FOR INTERVENTION RESEARCH

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS UNITED STATES AIR FORCE ACADEMY

USAF ACADEMY COLORADO

MEMORANDUM FOR Maj Don Veverka 13 July 2000

FROM: HQ USAFA/XPR

SUBJECT: Protocol Approval with Changes

1. The USAFA Institutional Review Board considered your amendment to FAC1999015 Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel, at its June, 2000 meeting. The Amendment received unanimous approval as minimal risk pending the following changes: (1) Clarification of who will monitor the cycle test. (2) Clarify in the Procedures section of the protocol and ICD the difference between participation in the experimental group and the control group. (3) Remove the incentive statement from the recruitment material.

2. You cannot recruit subjects or begin data collection until the required changes have been completed and approved by our office.

3. If you have any questions or I can be of further assistance, please don't hesitate to contact me at 333-3091or the IRB Chair, Dr. George Mastroianni, 333-4218.

Kathleen A. O'Donnell

Dr. Kathleen A. O'Donnell
USAFA IRB Administrator

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS UNITED STATES AIR FORCE ACADEMY

USAF ACADEMY COLORADO

MEMORANDUM FOR Maj Donald Veverka 13 July 2000

FROM: HQ USAFA/XPR

SUBJECT: Approval of IRB Required Changes

1. The USAFA Institutional Review Board Administrator has reviewed the changes that you submitted for your amendment to protocol FAC1999015 Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel in accordance with IRB requirements. All IRB required changes have been completed.

2. You are approved to begin your research and recruit 100 subjects. Do not exceed the number of subjects for which you have been approved. If you will need additional subjects, please send a letter to the IRB Chair or Administrator requesting additional subjects.

3. Please place the following statement at the bottom of your recruitment material: 'Approved: USAFA IRB FAC1999015'. This will inform potential subjects that your research has been reviewed and approved.

4. A final report or progress report is due to our office by 31 June 2001. If we have not received a final report, we will send you a progress report reminder 1 month prior to it being due. A sample format for these reports is located on our web page: http://www.usafa.af.mil/irb/FinlFmt.doc

5. When you submit a final report for this research, all original informed consent documents must accompany the final report.

6. If you have any questions or I can be of further assistance, please don't hesitate to contact me at 333-3091or the IRB Chair, Dr. George Mastroianni, 333-4218.

Kathleen A. O'Donnell

Dr. Kathleen A. O'Donnell
USAFA IRB Administrator

COPY

Colorado State University

Office of Regulatory Compliance
Office of Vice President for Research
and Information Technology
Fort Collins, CO 80523-2046
(970) 491-1563
FAX: (970) 491-2293

MEMORANDUM

TO: Jennifer Anderson, Food Science and Human Nutrition, 1571

FROM: Celia S. Walker, Administrator
Human Research Committee

SUBJECT: PROJECT APPROVAL
Title: Efficacy of the Transtheroretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel.
Protocol No.: 99-081H
Funding Agency: USAF Academy
Funding Agency Deadline: N/A

DATE: August 3, 2000

I am pleased to inform you that the above-referenced project was approved by the Human Research Committee on June 15, 2000 for the period July 15, 2000 to July 15, 2001 with the condition that the attached consent forms are signed by the subjects and each subject is given a copy of the form. It is the investigator's responsibility to obtain this consent form from all subjects. *NO changes may be made to this document without first obtaining the approval of the Committee.* **The Committee understands that 100 of the 150 approved participants will be studied for the intervention portion of the project. The attached recruitment poster has been approved.**

A status report of this project will be required within a 12-month period from the date of approval. You will be sent a reminder approximately two months before the protocol expires. The Principal Investigator will report on the numbers of subjects who have participated this year and project-to-date, about problems encountered, and provide a verifying copy of the consent form or cover letter used. The necessary form (H-101) is available from the Regulatory Compliance web page (see below). Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.

It is the responsibility of the investigator to immediately inform the Committee of any serious complications, unexpected risks, or injuries resulting from this research. It is also the investigator's responsibility to notify the Committee of any changes in experimental design, participant population, or consent procedures or documents. This can be done with a memo which completely describes the changes and their consequences (new consent form or cover letter, or altered survey instrument, for example). Students serving as Co-Principal Investigators may not alter projects without first obtaining PI approval. The PI is ultimately responsible for the conduct of the project.

This approval is issued under Colorado State University's OPRR Multiple Projects Assurance M-1153-01 issued August 1, 1996. If approval did not accompany a proposal when it was submitted to a sponsor, it is the researcher's responsibility to provide the sponsor with the approval notice.

Please direct any questions about the Committee's action on this project to me for routing to the Committee.

Additional information is available from the Regulatory Compliance web site at www.research.colostate.edu/regulatory/

Attachment

xc: Don Veverka w/attachment

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS UNITED STATES AIR FORCE ACADEMY

USAF ACADEMY COLORADO

MEMORANDUM FOR Maj Don Veverka

4 October 2000

FROM: HQ USAFA/XPR

SUBJECT: IRB Approval

1. The USAFA Institutional Review Board considered the amendment to protocol FAC1999015 Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel at its September 2000 meeting. The amendment received unanimous approval as minimal risk.

2. You are approved to execute the changes to the protocol.

3. If you have any questions or I can be of further assistance, please don't hesitate to contact me at 333-3091or the IRB Chair, Dr. George Mastroianni at 333-4218.

Dr. Kathleen A. O'Donnell
USAFA IRB Administrator

Colorado State University

Office of Regulatory Compliance
Office of Vice President for Research
and Information Technology
Fort Collins, CO 80523-2046
(970) 491-1563
FAX: 491-2293

AMENDMENT APPROVAL

MEMORANDUM

To: Jennifer Anderson, Food Science and Human Nutrition, 1571

From: Linda Kovar, Administrator for the Human Research Committee LK

Date: October 20, 2000

Re: Efficacy of the Transtheroretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel, 99-081H

Request to Amend

The Human Research Committee reviewed and approved your request to amend the above-referenced project: Effective October 9, 2000, approval is given to amend the project according to the e-mail request dated October 2, 2000. Approval is given with the condition that a copy of the Air Force Academy Institiutional Review Board approval of these amendments is provided to the Human Research Committee.

This approval is issued under Colorado State University's OPRR Multiple Projects Assurance M-1153-01 issued August 1, 1996.

If you have questions, please contact me at 1-0232 or Linda.Kovar@colostate.edu.

Watch our web page at http://www.research.colostate.edu/regulatory/ for current information and forms for human research.

xc: Don Veverka

Nutrition and Exercise Research Study: Efficacy of the Transtheoretical Model in Improving Nutrition and Exercise Habits in U.S. Air Force Personnel

In September 2000, a Colorado State University doctoral research study will be initiated to evaluate the effectiveness of an exercise and nutrition program to improve fitness in USAF personnel. Using advanced web based computer technology, health information will be provided by way of a web site to modify nutrition and exercise habits. This Air Force funded study is in response to USAF efforts towards enhancing military readiness through a fit and healthy force.

Recruitment is now underway to participate in this upcoming 8-month study. Eligibility to participate in this first study is limited to USAF male enlisted active duty personnel, aged 30-44. Participation must be approved in advance from unit leadership. Volunteer participants should not be enrolled in any USAF weight or fitness management programs and cannot have an existing medical condition under treatment by a physician. In addition, participants should not be using any medications (blood pressure, heart, diabetes, asthma, pain, etc.).

To learn more about this study and/or participating, please contact the co-principal research investigator at 548-0834.

Principal Research Investigator:
Jennifer Anderson, PhD, RD
Department of Food Science and Human Nutrition
Colorado State University
Fort Collins, CO 80523
jela@lamar.colostate.edu
(970) 491-7334

Co-principal Research Investigator:
Donald Veverka, MS
Department of Food Science and Human Nutrition
Colorado State University
Fort Collins, CO 80523
veverkas@att.net
(719) 548-0834

COPY

Colorado State University

Office of Regulatory Compliance
Office of Vice President for Research
and Information Technology
Fort Collins, CO 80523-2046
(970) 491-1563
FAX: (970) 491-2293

MEMORANDUM

TO: Jennifer Anderson, Food Science and Human Nutrition, 1571

FROM: Celia S. Walker, Regulatory Administrator for the Human Research Committee

SUBJECT: **PROJECT APPROVAL**
Title: Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel.
Protocol No.: 99-081H
Funding Agency: USAF Academy
Funding Agency Deadline: N/A

DATE: June 21, 2001

I am pleased to inform you that the above-referenced project was approved by the Human Research Committee on June 13, 2001 for the period July 15, 2001 to July 15, 2002 with the condition that the attached consent form is signed by the subjects and each subject is given a copy of the form. It is the investigator's responsibility to obtain this consent form from all subjects. *NO changes may be made to this document without first obtaining the approval of the Committee.*

A status report of this project will be required within a 12-month period from the date of approval. You will be sent a reminder approximately two months before the protocol expires. The Principal Investigator will report on the numbers of subjects who have participated this year and project-to-date, about problems encountered, and provide a verifying copy of the consent form or cover letter used. The necessary form (H-101) is available from the Regulatory Compliance web page (see below). Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.

It is the responsibility of the investigator to immediately inform the Committee of any serious complications, unexpected risks, or injuries resulting from this research. It is also the investigator's responsibility to notify the Committee of any changes in experimental design, participant population, or consent procedures or documents. This can be done with a memo which completely describes the changes and their consequences (new consent form or cover letter, or altered survey instrument, for example). Students serving as Co-Principal Investigators may not alter projects without first obtaining PI approval. The PI is ultimately responsible for the conduct of the project.

This approval is issued under Colorado State University's OPRR Multiple Projects Assurance M-1153-01 issued August 1, 1996. If approval did not accompany a proposal when it was submitted to a sponsor, it is the researcher's responsibility to provide the sponsor with the approval notice.

Please direct any questions about the Committee's action on this project to me for routing to the Committee.

Additional information is available from the Regulatory Compliance web site at www.research.colostate.edu/regulatory/

Attachment
xc: Don Veverka w/attachment

Colorado State University
Informed Consent to Participate in a Research Project

TITLE OF PROJECT: Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel

NAME OF PRINCIPAL INVESTIGATOR: Jennifer Anderson, Ph.D., RD, Professor and Extension Specialist

NAME OF CO-INVESTIGATOR: Don Veverka, MS, Assistant Professor

CONTACT NAME AND PHONE NUMBER FOR QUESTIONS OR PROBLEMS: Don Veverka (719) 548-0834

SPONSOR OF PROJECT: 10th Medical Group, Peterson Air Force Base, United States Air Force

PURPOSE OF THE RESEARCH: The purpose of the research is to evaluate a nutrition and exercise program that will contribute to a healthy lifestyle within the USAF. Specifically, studying a method to increase physical activity and promote good eating habits which may improve overall fitness.

PROCEDURES/METHODS TO BE USED: Information regarding the effectiveness of the program will be gathered via 100 volunteers in a study that will last approximately 8 months. Participation will either be in a control (no nutrition and exercise program) or treatment (receive nutrition and exercise program) group and requires completing written surveys and undergoing physical measurements as part of the study (listed below). Any gathered information (written and physical) will be kept in a secure locked location, identified only by coded numbers and accessible only to the research investigators. In accordance with United States Air Force research policy, this information will be kept secure for a period of three years and then subsequently destroyed.

a. blood cholesterol levels (from a blood draw sample taken at Peterson AFB Lab)
b. height
c. weight
d. percent body fat (using current USAF taping methods)
e. blood pressure
f. waist-to-hip ratio (using current USAF taping methods)
g. cycle ergometry scores (using routine USAF cycle ergometry methods)
h. resting heart rate (from current USAF cycle ergometry test)
i. demographic information
j. Dietary intake habits
k. Physical activity habits

RISKS INHERENT IN THE PROCEDURE: There are no substantial risks to the individual. It is not possible to identify all potential risks in an experimental procedure, but researchers have taken reasonable safeguards to minimize both the known and the potential, but unknown, risks.

 Subject Initials_______ Date_______

BENEFITS: You will have the opportunity to use a program which may change your nutrition and exercise habits, and possibly improve your fitness. The ultimate goal of the study is to evaluate the effectiveness of this program for instituting a healthy lifestyle in yourself and others and help the USAF plan and conduct successful healthy lifestyle programs.

CONFIDENTIALITY: All the information collected by the researcher will be identified with code numbers and not names. Only the Principal Investigator and Co- Principal Investigator will have access to information linked to individuals.

LIABILITY: The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury.

Questions about subjects' rights may be directed to Celia S. Walker at (970) 491-1563

PARTICIPATION: Your participation in this research is voluntary. If you decide to participate in this study, you may withdraw your consent and stop participating at any time without penalty or loss of benefits to which you are otherwise entitled.

Additionally, You may volunteer as a participant for subsequent follow-up research at Peterson AFB that will study the results of this program one year later. If you wish to be contacted to participate in this later study, please initial here_______.

Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing _______ pages.

____
Participant Name (printed)

______________________________ ______________
Participant signature **Date**

______________________________ ______________
Co-Investigator or Research Staff signature **Date**

INFORMED CONSENT DOCUMENT

DEPARTMENT OF THE AIR FORCE

USAF ACADEMY, COLORADO, 80840

Privacy Act and Freedom of Information Act

I understand that records of my participation in this study may only be released in accordance with federal law. The Freedom of Information Act, 5 U.S.C. 552, the Federal Privacy Act, 5 U.S.C. 552a, and their implementing regulations may apply.

TITLE OF STUDY

Efficacy of the Transtheoretical Model in Improving Exercise and Nutritional Habits in Air Force Personnel

INVESTIGATORS' NAME(S), DEPARTMENT(S), PHONE NUMBER(S)

Donald Veverka, Colorado State University, (719) 548-0834

PURPOSE OF STUDY

I understand that I am being asked to participate in a research study. The purpose of the study is to develop and then evaluate an alternative nutrition and exercise program. Information regarding the effectiveness of the program will be gathered via 100 volunteers in a study that will last approximately 8 months. I will be asked to participate in either a control (will not have access to any web-based nutrition and exercise information) or treatment (will have access to web-based nutrition and exercise information) group and understand I will also need to complete written surveys and undergo physical measurements as part of the study. My total time commitment for this study will be approximately eight months. Depending on which group I am selected for randomly, my specific duty time involvement will be as follows:

	Control Group	Treatment Group
Meetings/complete surveys	2 hours	2 hours
Blood draw	0.5 hours	0.5 hours
Cycle ergometry testing and body measurements	1 hour	1 hour
Review messages on web	_______	6 hours
TOTAL	3.5 hours	9.5 hours

BENEFITS

I understand there are no direct benefits to me for my participation in this study

RISKS/INCONVENIENCES

I understand I must receive permission from my unit leadership to complete the requirements associated with the study during duty hours (as outlined in section 2 under "procedures")

COMPENSATION FOR TREATMENT OF INJURY

I understand that my entitlement to medical and dental care and/or compensation in the event of injury is governed by federal laws and regulations. If I have questions about my rights or if I believe I have received a research-related injury, I may contact the USAF Academy Institutional Research and Assessment Division (HQ USAFA/XPR) at 719-333-2587.

DECISION TO PARTICIPATE

The decision to participate in this study is completely voluntary on my part. No one has coerced or intimidated me into participating in this program. I understand that if I refuse to participate, I will not lose any benefits that I am entitled to. I am participating because I want to. My investigator has adequately answered any and all questions I have about this study, my participation, and the procedures involved. I understand that an investigator will be available to answer any questions concerning procedures throughout this study. I understand that if significant new findings develop during the course of this study that may relate to my decision to continue participation, I will be informed. I further understand that I may withdraw this consent at any time and discontinue further participation in this study without prejudice to my rights. I also understand that the investigator may terminate my participation in this study at any time if he/she feels this to be in my best interest. I have been provided a copy of this consent form.

QUESTIONS REGARDING MY PARTICIPATION IN THIS RESEARCH STUDY

If I have questions about this research study, I should contact the co-principal investigator, Don Veverka, at (719) 548-0834. If I have questions about my rights as a research subject, or if I have received a research-related injury, I should contact the USAF Academy Institutional Research and Assessment Division (HQ USAFA/XPR) at 719-333-2587.

My signature below indicates my willingness to participate in this research study.

____________________ Subject's printed name	________________ Subject's SSAN
____________________ Subject's signature	________________ Date

____________________ Advising Investigator's Signature	________________ Advising Investigator's SSAN	____________ Date
____________________ Witness' Signature	________________ Witness's SSAN	____________ Date

Distribution: Principal Investigator and Subject.

APPROVED: USAFA IRB FAC1999015

APPENDIX H

DEMOGRAPHIC QUESTIONNAIRE FOR INTERVENTION RESEARCH

DEMOGRAPHIC SURVEY

This demographic survey is part of the intervention study you will be participating in over the next several months. It asks for information that is relevant to this particular research on nutrition and physical activity. Your assistance in completing this survey will help us develop healthy lifestyle programs for men and women in the United States Air Force. Answer the questions to the best extent possible following the instructions given. *Do not place your name or SSAN on any part of this survey*. *Use only the code number you were given prior to receiving this survey*. All information will be kept confidential and used only for purposes of research and study.

CODE NUMBER:_____ **Date:_____________**

1. Age: _________

2. Ethnicity:

   _________Caucasian
   _________Afro-American
   _________Native American
   _________Asian
   _________Hispanic
   _________Other

3. Education level completed: ________ High school
   ________ Some college
   ________ College (4 or more years)
   ________ Graduate college (Masters, Doctorate, etc..)

4. Current job: ___________________________

5. Current rank (SSgt, TSgt, etc.): _______________

6. Years of service on active duty: _______________

7. Are you currently using any type of tobacco product (to include smokeless products)?

   ________ yes ________ no

8. Is there any history of chronic disease in your family (cancer, coronary heart disease, diabetes, etc.) ?

   ________ yes ________ no

Thank you for your assistance in completing this survey!

APPENDIX I

FOOD FREQUENCY QUESTIONNAIRE

RESPONDENT ID NUMBER

0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9

TODAY'S DATE

	DAY		YEAR
O Jan			
O Feb			
O Mar	0	0	1998 O
O Apr	1	1	1999 O
O May	2	2	2000 O
O Jun	3	3	2001 O
O Jul		4	2002 O
O Aug		5	2003 O
O Sep		6	2004 O
O Oct		7	2005 O
O Nov		8	2006 O
O Dec		9	2007 O

FOOD QUESTIONNAIRE

This form is about the foods you usually eat.
It will take about 30 - 40 minutes to complete.

- Please answer each question as best you can. Estimate if you aren't sure.
- Use only a No. 2 pencil.
- Fill in the circles completely, and erase completely if you make any changes.

Please print your name in this box.

SEX
O Male
O Female

If female, are you pregnant or breast feeding?
O No
O Yes
O Not female

AGE		WEIGHT pounds			HEIGHT ft.	in.
0	0	0	0	0		0
1	1	1	1	1		1
2	2	2	2	2		2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5		5	5	5	5
6	6		6	6	6	6
7	7		7	7		7
8	8		8	8		8
9	9		9	9		9
						10
						11

First, a few general questions about what you eat.	AVERAGE USE IN THE PAST YEAR: LESS THAN ONCE per WEEK	1-2 per WEEK	3-4 per WEEK	5-6 per WEEK	1 per DAY	1 1/2 per DAY	2 per DAY	3 per DAY	4+ per DAY
About how many servings of vegetables do you eat, per day or per week, not counting salad or potatoes?	O	O	O	O	O	O	O	O	O
About how many servings of fruit do you eat, not counting juices?	O	O	O	O	O	O	O	O	O
How often do you eat cold cereal?	O	O	O	O	O	O	O	O	O
How often do you use fat or oil in cooking?	O	O	O	O	O	O	O	O	O

What kinds of fat or oil do you usually use in cooking? MARK ONLY ONE OR TWO

O Don't know, or Pam
O Stick margarine
O Soft tub margarine
O Butter
O Butter/margarine blend
O Low-fat margarine
O Corn oil, vegetable oil
O Olive oil or canola oil
O Lard, fatback, bacon fat
O Crisco

PLEASE DO NOT WRITE IN THIS AREA

75821

During the past year, have you taken any vitamins or minerals regularly, at least once a month?

O No, not regularly   O Yes, fairly regularly →

(IF YES) WHAT DID YOU TAKE FAIRLY REGULARLY?

VITAMIN TYPE	HOW OFTEN					FOR HOW MANY YEARS?					
	DIDN'T TAKE	A FEW DAYS per MONTH	1-3 DAYS per WEEK	4-6 DAYS per WEEK	EVERY DAY	LESS THAN 1 YR.	1 YEAR	2 YEARS	3-4 YEARS	5-9 YEARS	10+ YEARS
Multiple Vitamins. Did you take...											
Regular Once-A-Day, Centrum, or Thera type	O	O	O	O	O	O	O	O	O	O	O
Stress-tabs or B-Complex type	O	O	O	O	O	O	O	O	O	O	O
Antioxidant combination type	O	O	O	O	O	O	O	O	O	O	O
Single Vitamins (not part of multiple vitamins)											
Vitamin A (not beta-carotene)	O	O	O	O	O	O	O	O	O	O	O
Beta-carotene	O	O	O	O	O	O	O	O	O	O	O
Vitamin C	O	O	O	O	O	O	O	O	O	O	O
Vitamin E	O	O	O	O	O	O	O	O	O	O	O
Folic acid, folate	O	O	O	O	O	O	O	O	O	O	O
Calcium, alone or combined with something else	O	O	O	O	O	O	O	O	O	O	O
Zinc, alone or combined with something else	O	O	O	O	O	O	O	O	O	O	O
Iron	O	O	O	O	O	O	O	O	O	O	O
Selenium	O	O	O	O	O	O	O	O	O	O	O

If you took Once-a-day, Centrum or Thera-type multiple vitamins, did you usually take types that O contain minerals, iron, zinc, etc. O do not contain minerals O don't know

If you took vitamin C or vitamin E:

How many milligrams of **vitamin C** did you usually take, on the days you took it?
O 100 O 250 O 500 O 750 O 1000 O 1500 O 2000 O 3000+ O Don't know

How many IUs of **vitamin E** did you usually take, on the days you took it?
O 100 O 200 O 300 O 400 O 600 O 800 O 1000 O 2000+ O Don't know

Did you take any of these supplements at least once a month?

O Ginkgo O Ginseng O St. John's Wort O Kava Kava O Echinacea O Melatonin O DHEA
O Glucosamine/Chondroitin O Something else O Didn't take these

---

The next section is about your usual eating habits in the past year or so. This includes all meals or snacks, at home or in a restaurant or carry-out. There are two kinds of questions to answer for each food:

HOW OFTEN, on average, did you eat the food during the past year?

•Please DO NOT SKIP any foods. Mark "Never" if you didn't eat it.

HOW MUCH did you usually eat of the food?

•Sometimes we ask how many you eat, such as 1 egg, 2 eggs, etc., ON THE DAYS YOU EAT IT.
•Sometimes we ask "how much" as A, B, C or D. LOOK AT THE ENCLOSED PICTURES. For each food, pick the picture (bowls or plates) that looks the most like the serving size you usually eat.
(If you don't have pictures: A=1/4 cup, B=1/2 cup, C=1 cup, D=2 cups.)
•Sometimes we made the "D" column a darker color. This is just to remind you to make sure you really eat that large a serving.

EXAMPLE: *This person drank apple juice twice a week, and had one glass each time. Once a week he ate a "C" sized serving of rice (about 1 cup).*

HOW OFTEN	NEVER	A FEW TIMES per YEAR	ONCE per MON.	2-3 TIMES per MON.	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
Apple juice	O	O	O	O	O	●	O	O	O	How many glasses each time	● 1	O 2	O 3	O 4
Rice	O	O	O	O	●	O	O	O	O	How much each time	O A	O B	● C	O D

HOW OFTEN	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME How many glasses on the days you drink it?				
How often do you drink the following beverages?														
Tomato juice or V-8 juice	O	O	O	O	O	O	O	O	O	How many glasses each time	O 1	O 2	O 3	
Real 100% orange juice or grapefruit juice, including fresh, frozen or bottled	O	O	O	O	O	O	O	O	O	How many glasses each time	O 1	O 2	O 3	

When you drink orange juice, how often do you drink a calcium-fortified brand?

O Usually calcium-fortified
O Sometimes calcium-fortified
O Hardly ever calcium-fortified
O I don't know
O I don't drink orange juice

Other real fruit juices like apple juice, prune juice, lemonade	O	O	O	O	O	O	O	O	O	How many glasses	O 1	O 2	O 3	
Kool-Aid, Hi-C, or other drinks with added vitamin C	O	O	O	O	O	O	O	O	O	How many glasses	O 1	O 2	O 3	
Drinks with some juice in them, like Sunny Delight, Juice Squeeze	O	O	O	O	O	O	O	O	O	How many bottles	O 1	O 2	O 3	
Instant breakfast milkshakes like Carnation, diet shakes like SlimFast, or liquid supplements like Ensure	O	O	O	O	O	O	O	O	O	How many glasses or cans	O 1	O 2	O 3	O 4
Glasses of milk (any kind)	O	O	O	O	O	O	O	O	O	How many glasses	O 1	O 2	O 3	O 4

When you drink glasses of milk, what kind do you usually drink? **MARK ONLY ONE:**

O Whole milk
O Reduced-fat 2% milk
O Low-fat 1% milk
O Non-fat milk
O Rice milk
O Soy milk
O I don't drink milk or soy milk

HOW OFTEN	NEVER	FEW/YEAR	ONCE/MONTH	2-3 TIMES/MONTH	ONCE/WEEK	TWICE/WEEK	3-4 TIMES/WEEK	5-6 TIMES/WEEK	EVERY DAY	HOW MUCH EACH TIME				
Regular soft drinks, or bottled drinks like Snapple (not diet drinks)	O	O	O	O	O	O	O	O	O	How many bottles or cans	O 1	O 2	O 3-4	O 5+
Beer or non-alcoholic beer	O	O	O	O	O	O	O	O	O	How many bottles or cans	O 1	O 2	O 3-4	O 5+

What kind? **MARK ONLY ONE:** O Regular beer O Light beer O Non-alcoholic beer O I don't drink beer

Wine or Wine coolers	O	O	O	O	O	O	O	O	O	How many glasses	O 1	O 2	O 3-4	O 5+
Liquor or mixed drinks	O	O	O	O	O	O	O	O	O	How many drinks	O 1	O 2	O 3-4	O 5+
Glasses of water, tap or bottled	O	O	O	O	O	O	O	O	O	How many glasses	O 1	O 2	O 3-4	O 5+
Coffee, regular or decaf	O	O	O	O	O	O	O	O	O	How many cups	O 1	O 2	O 3-4	O 5+
Tea or iced tea (not herb teas)	O	O	O	O	O	O	O	O	O	How many cups	O 1	O 2	O 3-4	O 5+

What do you usually add to coffee? **MARK ONLY ONE:** O Cream or half & half O Nondairy creamer O Milk O None of these

What do you usually add to tea? **MARK ONLY ONE:** O Cream or half & half O Nondairy creamer O Milk O None of these

Do you usually add sugar (or honey) to coffee? O No O Yes IF YES, how many teaspoons each cup? ① ② ③ ④

Do you usually add sugar (or honey) to tea? O No O Yes IF YES, how many teaspoons each cup? ① ② ③ ④

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PLEASE DO NOT WRITE IN THIS AREA

HOW OFTEN	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
How often do you eat each of the following fruits, just during the 2-3 months when they are in season?														
Raw peaches, apricots, nectarines, while they are in season	O	O	O	O	O	O	O	O	O	How many each time	O 1/2	O 1	O 2	O 3
Cantaloupe, in season	O	O	O	O	O	O	O	O	O	How much	O 1/8	O 1/4	O 1/2	O 1
Strawberries, in season	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Watermelon, in season	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Any other fruit in season, like grapes, honeydew, pineapple, kiwi	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
How often do you eat the following foods all year round? Estimate your average for the whole year.														
Bananas	O	O	O	O	O	O	O	O	O	How many each time	O 1/2	O 1	O 2	O 3
Apples or pears	O	O	O	O	O	O	O	O	O	How many each time	O 1/2	O 1	O 2	O 3
Oranges or tangerines	O	O	O	O	O	O	O	O	O	How many each time	O 1/2	O 1	O 2	O 3
Grapefruit	O	O	O	O	O	O	O	O	O	How much	O 1/2	O 1	O 2	O 3
Canned fruit like applesauce, fruit cocktail, or dried fruit like raisins	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
HOW OFTEN	NEVER	FEW/ YEAR	ONCE/ MONTH	2-3 TIMES/ MONTH	ONCE/ WEEK	TWICE/ WEEK	3-4 TIMES/ WEEK	5-6 TIMES/ WEEK	EVERY DAY	**HOW MUCH EACH TIME**				
Eggs, including egg biscuits or Egg McMuffins (Not egg substitutes)	O	O	O	O	O	O	O	O	O	How many eggs each time	O 1	O 2	O 3	O 4
Bacon	O	O	O	O	O	O	O	O	O	How many pieces	O 1	O 2	O 3	O 4
Breakfast sausage, including sausage biscuits	O	O	O	O	O	O	O	O	O	How many pieces	O 1	O 2	O 3	O 4
Pancakes, waffles, French toast, Pop Tarts	O	O	O	O	O	O	O	O	O	How many pieces	O 1	O 2	O 3	O 4
Breakfast bars, granola bars, Power bars	O	O	O	O	O	O	O	O	O	How many	O 1	O 2	O 3	O 4
Cooked cereals like oatmeal, cream of wheat or grits	O	O	O	O	O	O	O	O	O	Which bowl		O B	O C	O D
High-fiber cereals like All Bran, Raisin Bran, Fruit-n-Fiber	O	O	O	O	O	O	O	O	O	Which bowl		O B	O C	O D

Which high-fiber cereal do you eat most often? MARK ONLY ONE: O All Bran or Bran Buds O Raisin Bran O Fiber One, Fruit-n-Fiber, etc. O Something else O I don't know O I don't eat it

Product 19, Just Right or Total cereal	O	O	O	O	O	O	O	O	O	Which bowl		O B	O C	O D
Any other cold cereal, like Corn Flakes, Cheerios, Special K	O	O	O	O	O	O	O	O	O	Which bowl		O B	O C	O D
Milk or milk substitutes on cereal	O	O	O	O	O	O	O	O	O	How many oz. on cereal	O 3 oz.	O 4-5 oz.	O 6-7 oz.	O 8+ oz.
Yogurt or frozen yogurt	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Cheese, sliced cheese or cheese spread, including on sandwiches	O	O	O	O	O	O	O	O	O	How many slices	O 1	O 2	O 3	O 4

When you eat cheese, is it O Usually low-fat O Sometimes low-fat O Hardly ever low-fat O Don't know/don't eat

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HOW OFTEN	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
How often do you eat the following vegetables, including fresh, frozen, canned or in stir-fry, at home or in a restaurant?														
Broccoli	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Carrots, or mixed vegetables or stews containing carrots	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Corn	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Green beans or green peas	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Spinach	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Mustard greens, turnip greens, collards	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
French fries, fried potatoes or hash browns	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
White potatoes not fried, incl. boiled, baked, mashed & potato salad	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Sweet potatoes, yams (Not in pie)	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Cole slaw, cabbage	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Green salad	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Raw tomatoes, including in salad	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Salad dressing	O	O	O	O	O	O	O	O	O	How many Tbsp.	O 1	O 2	O 3	O 4
Is your salad dressing O Usually low-fat O Sometimes low-fat O Hardly ever low-fat O Don't know/don't use														
HOW OFTEN	NEVER	FEW/YEAR	ONCE/MONTH	2-3 TIMES/MONTH	ONCE/WEEK	TWICE/WEEK	3-4 TIMES/WEEK	5-6 TIMES/WEEK	EVERY DAY	HOW MUCH EACH TIME				
Any other vegetable, like okra, squash, cooked green peppers	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Refried beans or bean burritos	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Chili with beans (with or without meat)	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Baked beans, black-eye peas, pintos, any other dried beans	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Vegetable stew	O	O	O	O	O	O	O	O	O	Which Bowl		O B	O C	O D
Vegetable soup, vegetable beef, chicken vegetable, or tomato soup	O	O	O	O	O	O	O	O	O	Which Bowl		O B	O C	O D
Split pea, bean or lentil soup	O	O	O	O	O	O	O	O	O	Which Bowl		O B	O C	O D
Any other soup, like chicken noodle, chowder, mushroom, instant soups	O	O	O	O	O	O	O	O	O	Which Bowl		O B	O C	O D
Spaghetti, lasagna or other pasta <u>with tomato sauce</u>	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Cheese dishes <u>without</u> tomato sauce, like macaroni and cheese	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Pizza, including carry-out	O	O	O	O	O	O	O	O	O	How many slices	O 1	O 2	O 3	O 4

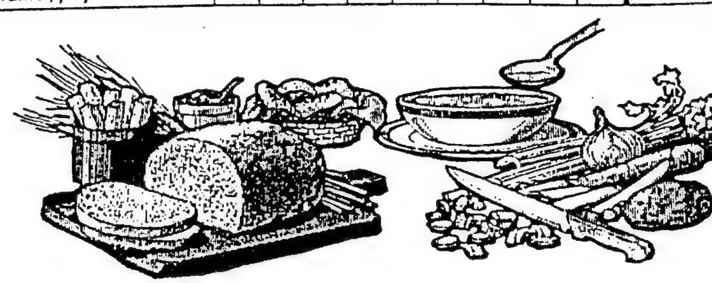
HOW OFTEN	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME (SEE PORTION SIZE PICTURES FOR A-B-C-D)				
Do you ever eat chicken, meat or fish? O Yes O No IF NO, SKIP TO NEXT PAGE														
Hamburgers, cheeseburgers, meat loaf, at home or in a restaurant	O	O	O	O	O	O	O	O	O	How much meat	O 1/8 lb.	O 1/4 lb.	O 1/2 lb.	O 3/4 lb.
Tacos, burritos, enchiladas, tamales, etc. with meat or chicken	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Beef steaks, roasts, pot roast, or in frozen dinners or sandwiches	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
How do you like beef cooked? O Rare O Medium O Well done O I don't eat beef														
Pork chops, pork roasts, or dinner ham	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
When you eat meat, do you - O Avoid eating the fat O Sometimes eat the fat O Often eat the fat O I don't eat meat														
Veal, lamb or deer meat	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Ribs, spareribs	O	O	O	O	O	O	O	O	O	How many ribs	O 1-3	O 4-6	O 7-8	O 9+
Liver, including chicken livers or liverwurst	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Gizzard, pork neckbones, chitlins, pigs feet, etc.	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Mixed dishes with beef or pork, like stew, corned beef hash, stuffed cabbage, meat dish with noodles	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Mixed dishes with chicken, like chicken casserole, chicken & noodles, pot pie or in stir-fry	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Fried chicken, at home or in a restaurant	O	O	O	O	O	O	O	O	O	# medium pieces	O 1	O 2	O 3	O 4
Chicken or turkey not fried, such as baked, grilled, or on sandwiches	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
When you eat chicken, do you O Avoid eating the skin O Sometimes eat the skin O Often eat the skin														

HOW OFTEN	NEVER	FEW/YEAR	ONCE/MONTH	2-3 TIMES/MONTH	ONCE/WEEK	TWICE/WEEK	3-4 TIMES/WEEK	5-6 TIMES/WEEK	EVERY DAY	HOW MUCH EACH TIME				
Oysters	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Other shellfish like shrimp, scallops, crabs	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Tuna, tuna salad, tuna casserole	O	O	O	O	O	O	O	O	O	How much of the tuna	O A	O B	O C	O D
Fried fish or fish sandwich, at home or in a restaurant	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Other fish, not fried	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Hot dogs, or sausage like Polish, Italian or chorizos	O	O	O	O	O	O	O	O	O	How many	O 1	O 2	O 3	O 4
Are your hot dogs O Usually low-fat O Sometimes low-fat O Hardly ever low-fat O Don't know/don't eat them														
Boloney, sliced ham, turkey lunch meat, other lunch meat	O	O	O	O	O	O	O	O	O	How many slices	O 1	O 2	O 3	O 4
Are your lunch meats O Usually low-fat or turkey O Sometimes low-fat O Hardly ever low-fat														

HOW OFTEN	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME (SEE PORTION SIZE PICTURES FOR A-B-C-D)				
Noodles, macaroni, pasta salad	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Tofu, bean curd	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Meat substitutes, such as veggie burgers, Gardenburgers	○	○	○	○	○	○	○	○	○	How many patties	○ 1	○ 2	○ 3	○ 4
Chinese food, Thai or other Asian food, not counted above	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Snacks like potato chips, corn chips, popcorn (not pretzels)	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D

Are these snacks ○ Usually low-fat ○ Sometimes low-fat ○ Hardly ever low-fat ○ Don't know/don't eat

HOW OFTEN	NEVER	FEW/ YEAR	ONCE/ MONTH	2-3 TIMES/ MONTH	ONCE/ WEEK	TWICE/ WEEK	3-4 TIMES/ WEEK	5-6 TIMES/ WEEK	EVERY DAY	HOW MUCH EACH TIME				
Peanuts, other nuts or seeds	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Crackers	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Doughnuts, Danish pastry	○	○	○	○	○	○	○	○	○	How many	○ 1	○ 2	○ 3	○ 4
Cake, sweet rolls, coffee cake	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Are they ○ Usually low-fat ○ Sometimes low-fat ○ Hardly ever low-fat ○ Don't know/don't eat														
Cookies	○	○	○	○	○	○	○	○	○	How many	○ 1-2	○ 3-5	○ 6-7	○ 8+
Are your cookies ○ Usually low-fat ○ Sometimes low-fat ○ Hardly ever low-fat ○ I don't know/don't eat														
Ice cream, ice milk, ice cream bars	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Is your ice cream ○ Usually low-fat ○ Sometimes low-fat ○ Hardly ever low-fat ○ I don't know/don't eat														
Pumpkin pie, sweet potato pie	○	○	○	○	○	○	○	○	○	How many slices	○ 1/2	○ 1	○ 2	○ 3
Any other pie or cobbler	○	○	○	○	○	○	○	○	○	How many slices	○ 1/2	○ 1	○ 2	○ 3
Chocolate candy, candy bars	○	○	○	○	○	○	○	○	○	How many bars	○ small	○ medium	○ large	○ large
Other candy, not chocolate, like hard candy, caramel, jelly beans	○	○	○	○	○	○	○	○	○	How many pieces	○ 1-2	○ 3-5	○ 6-7	○ 8+



PLEASE DO NOT WRITE IN THIS AREA

HOW OFTEN	NEVER OR A FEW TIMES PER YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	2 TIMES per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	2+ TIMES per DAY	HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
Biscuits or muffins	O	O	O	O	O	O	O	O	O	How many each time	O 1	O 2	O 3	O 4
Rolls, hamburger buns, English muffins, bagels	O	O	O	O	O	O	O	O	O	How many each time	O 1/2	O 1	O 2	O 3
Dark bread like rye or whole wheat, including in sandwiches	O	O	O	O	O	O	O	O	O	How many slices each time	O 1	O 2	O 3	O 4
White bread or toast, including French, Italian, or in sandwiches	O	O	O	O	O	O	O	O	O	How many slices each time	O 1	O 2	O 3	O 4
Corn bread, corn muffins	O	O	O	O	O	O	O	O	O	How many pieces	O 1	O 2	O 3	O 4
Tortillas	O	O	O	O	O	O	O	O	O	How many each time	O 1	O 2	O 3	O 4
Rice, or dishes made with rice	O	O	O	O	O	O	O	O	O	How much	O A	O B	O C	O D
Margarine (not butter) on bread or on potatoes or vegetables, etc.	O	O	O	O	O	O	O	O	O	How many pats (tsp.)	O 1	O 2	O 3	O 4
Butter (not margarine) on bread or on potatoes or vegetables, etc.	O	O	O	O	O	O	O	O	O	How many pats (tsp.)	O 1	O 2	O 3	O 4
Gravy	O	O	O	O	O	O	O	O	O	How many Tbsp	O 1	O 2	O 3	O 4
Peanut butter	O	O	O	O	O	O	O	O	O	How many Tbsp	O 1	O 2	O 3	O 4
Jelly, jam, or syrup	O	O	O	O	O	O	O	O	O	How many Tbsp	O 1	O 2	O 3	O 4
Mayonnaise, sandwich spreads	O	O	O	O	O	O	O	O	O	How many Tbsp	O 1	O 2	O 3	O 4
Catsup, salsa or chile peppers	O	O	O	O	O	O	O	O	O	How many Tbsp	O 1	O 2	O 3	O 4
Mustard, soy sauce, steak sauce, barbecue sauce, other sauces	O	O	O	O	O	O	O	O	O	How many Tbsp	O 1	O 2	O 3	O 4

Did you use the pictures to choose your serving size on this form? O Yes O No O I didn't have any pictures.

Would you say your health is O Excellent O Very good O Good O Fair O Poor

How many times have you gone on a diet? O Never O 1-2 O 3-5 O 6-8 O 9 or more

Did you ever drink more beer, wine or liquor than you do now? O Yes O No

How many hours do you watch television or video, per day or per week on average?
O None O 1-6 hours/week O 1 hour/day O 2 hours/day O 3 hours/day O 4+ hours/day

Do you smoke cigarettes now? O No O Yes
IF YES, On the average about how many cigarettes a day do you smoke now?
O 1-5 O 6-14 O 15-24 O 25-34 O 35 or more

What language do you usually speak at home or with friends?
O English O Spanish O Something else O English & something else equally

What is your ethnic group? (MARK ONE OR MORE)
O Hispanic or Latino O Black or African American O American Indian or Alaska Native
O White, not Hispanic O Asian O Native Hawaiian or Other Pacific Islander

Thank you very much for filling out this questionnaire. Please take a minute to go back and fill in anything you may have skipped.

PLEASE DO NOT WRITE IN THIS AREA

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APPENDIX J

PHYSICAL ACTIVITY RECALL QUESTIONNAIRE

ACT Physical Activity Recall

ID ☐☐☐☐☐☐ Acrostic ☐☐☐☐☐☐

Date Completed ☐☐ ☐☐ ☐☐ (Mon / Day / Year) Visit Code ☐☐☐

Day of the week form completed : ____________________

1. Were you employed in the last seven days? 1☐ Yes 2☐ No

2. How many days of the last seven did you work? ☐ (round to nearest day)

3. How many total hours did you work in the last seven days? ☐☐ hours

4. What days of the week do you consider to be your weekend or non-work days? For most people this would be Saturday and Sunday but it may be different for you.

   1☐ Sunday 2☐ Monday 3☐ Tuesday 4☐ Wednesday 5☐ Thursday 6☐ Friday 7☐ Saturday

5. If you did not work your usual week, why did you work less than usual?

   ____

   ____

6. For the past seven days, and thinking only about activities that are ***at least*** of moderate intensity, how many days did you do activity or exercise that added up to at least 30 minutes each day?

   ☐ number of days (0 to 7)

Acrostic ☐☐☐☐☐☐

7. Was this a typical week in terms of your usual pattern of activity or exercise?

- 1☐ Yes
- 2☐ No — Were you more or less active in the past week than you usually are? 1☐ More 2☐ Less

Until now, we've just been talking about the last seven days. Now I would like you to think about your usual activities over the last three months.

8. During your work week, on average how many hours per day do you spend sitting quietly (e.g., watching TV, working at a desk or computer, eating, or reading)? ☐☐ average hours per day

During your weekend, on average how many hours per day do you spend sitting quietly. (e.g., watching TV, working at a desk or computer, eating, or reading)? ☐☐ average hours per day

9 How many flights of stairs do you climb up each day? (1 flight = 10 steps) ☐☐ number of flights

10. If you had to add together the total minutes you spend walking during the day, how many minutes would that be? Remember, add up your actual walking time and don't add in the time spent just standing Include your to and from walking and any fitness walking. Don't try to remember every step, just give a general idea of the time spent walking. ☐☐☐ total minutes per day.

11. What is your usual pace of walking? Mark ONE only.

- 1☐ Casual or strolling (less than 2 miles per hour)
- 2☐ Average or normal (2 to 3 miles per hour)
- 3☐ Fairly brisk (3 to 4 miles per hour)
- 4☐ Brisk or striding (4 miles per hour or faster)

12. Do you regularly do strength and flexibility exercises like sit-ups, push-ups, yoga, or stretching?

- 1☐ Yes — How many days per week do you do these exercises? ☐ number of days (0-7)
- 2☐ No

13. On the days that you do strength and flexibility exercises, how many minutes do you spend doing them? ☐☐☐ total minutes

Form completed by ☐☐ (staff code)

Acrostic

Yesterday | One Week Ago

	Days of the Week	HRS MIN	HRS MIN	HRS MIN	HRS MIN	HRS MIN	HRS MIN	HRS MIN
	Sleep	:	:	:	:	:	:	:
MORNING	Moderate	:	:	:	:	:	:	:
	Hard	:	:	:	:	:	:	:
	Very Hard	:	:	:	:	:	:	:
AFTERNOON	Moderate	:	:	:	:	:	:	:
	Hard	:	:	:	:	:	:	:
	Very Hard	:	:	:	:	:	:	:
EVENING	Moderate	:	:	:	:	:	:	:
	Hard	:	:	:	:	:	:	:
	Very Hard	:	:	:	:	:	:	:

Calculated Energy Expenditure . Kcal/kg/day